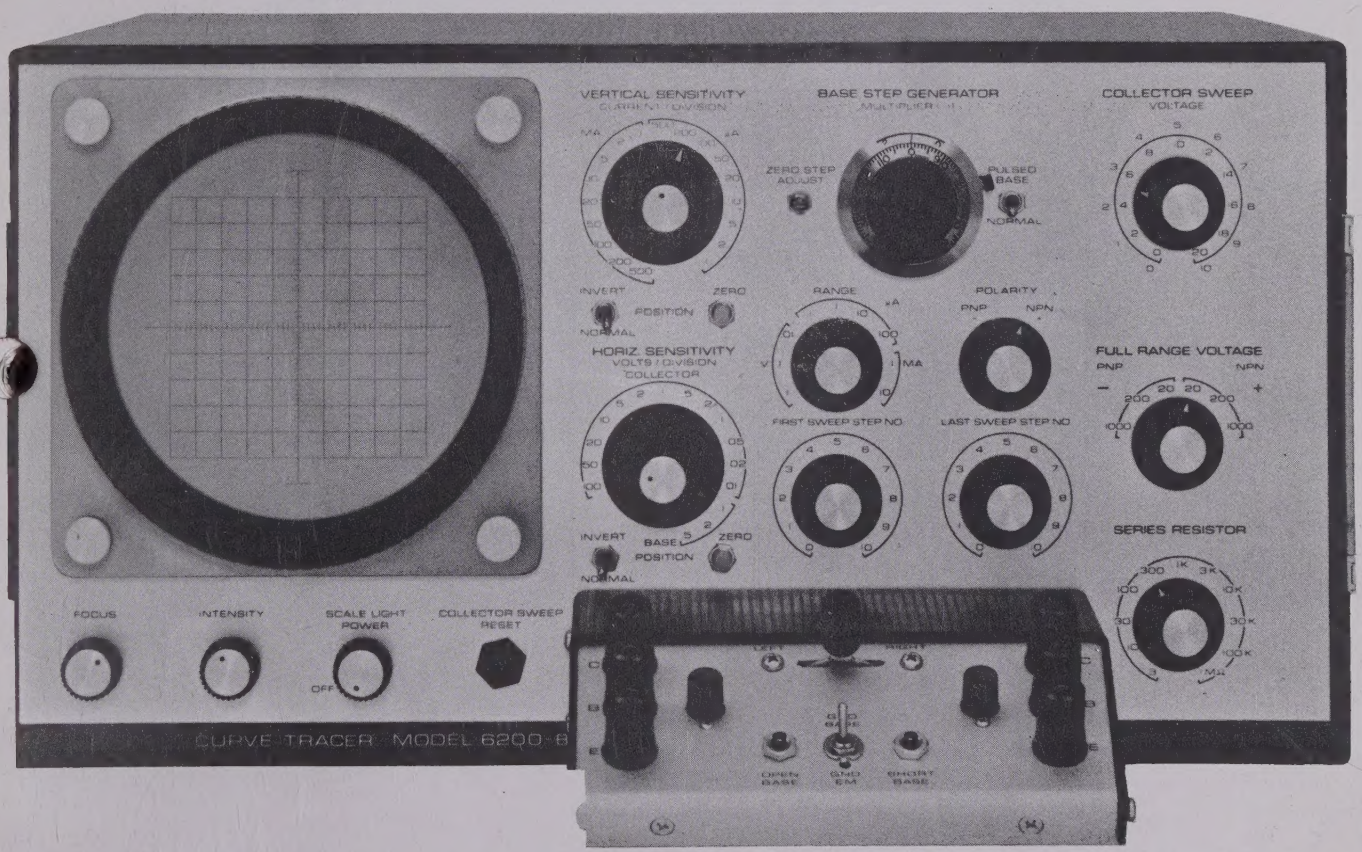
DECEMBER 1969

Measurement Products Division

INSTRUCTION MANUAL

MODEL 6200B/P



Programable Curve Tracer

K 115791/2

Measurement Products Division

MODEL 6200B/P-3509B

PROGRAMABLE CURVE TRACER

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SYSTRON DONNER CORPORATION

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WARNING

The COLLECTOR terminal of this instrument is capable of delivering lethal voltages and currents. If a device under test has a metal container internally connected to its collector terminal, these hazards also exist on the exterior of the device. Always set COLLECTOR SWEEP VOLTAGE control to 0 V (fully counter-clockwise) before inserting or removing a device from the test terminals. If a dual test socket adapter is used, always set the socket select switch to the center position before handling the device under test.

LIST OF EFFECTIVE PAGES

Model 6200B/P-12-69

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consisting of the following:

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Section I
General Information

1-1. INTRODUCTION

1-2. This manual contains specifications, operating instructions, and maintenance procedures for the Model 6200B/P Programable Curve Tracer. Section I contains specifications and a general description of the instrument. Section II details installation and shipping instructions. Section III describes operating procedures and programing methods. Section IV describes theory of operation (available at a later date). Section V lists maintenance, calibration, alignment, and troubleshooting procedures. Section VI lists replacement parts. An instruction manual for the Model 3509B Programer, companion unit for the Model 6200B/P, is contained in Appendix A of this manual.

1-3. DESCRIPTION

1-4. The Systron-Donner Model 6200B/P is a programable semiconductor curve tracer with emphasis on those features needed to quickly test the latest devices. Sequential tests of different parameters may be performed by appropriate programing of its companion unit, the 3509B. Thus, the programing options extended its capability into the areas of quality control, receiving inspection and production testing, without sacrificing its versatility as a laboratory instrument.

1-5. The following parameters are representative of those which can be automatically tested using the Model 6200B/P and the Model 3509B.

Diodes–BV_f, BV_r, I_a, etc.

Transistors–$H_{fe(min.\ \&\ max.)}$, $H_{fb(min.\ \&\ max.)}$, $V_{ce(sat)}$, $V_{be(sat)}$, $V_{be(on)}$, BV_{ces}, BV_{ceo}, BV_{cer}, BV_{cbo}, BV_{ebo}, BV_{eco}, LV_{ceo}, LV_{ces}, LV_{cer}, I_{ceo}, I_{cbo}, I_{ebo}, I_{ces}, I_f, etc.

Unijunctions–V_p, V_v, I_v, and above parameters.

SCR'S–BV_{gk}, BV_{ak}, I_{gf}, V_{gf}, V_f, V_r, I_h, V_{bo}.

FET'S–BV_{dss}, BV_{gss}, BV_{sgo}, BV_{dso}, BV_{dgo}, V_p, V_{gsf}, G_m.

1-6. The Model 6200B/P Programable Curve Tracer is capable of displaying up to five independent characteristic curves automatically and in sequential order. Each curve is developed by driving one terminal of a semiconductor with a constant voltage or current and then sweeping the others with a half sine wave of voltage. If more than one curve is to be drawn per display, the driving source is stepped through several values and the sweep is repeated once for each step. The horizontal deflection of the CRT trace is chosen to correspond with either the driving voltage or to the sweep voltage across the device under test. The vertical deflection corresponds to the current drawn from the sweep source. The adjustment of the display sensitivity for each tested parameter is fundamental to the instrument's operation and therefore, must also be programable. All of the functions of the Model 6200B/P which can be directly controlled through its reed relays by the Model 3509B Programer, are indicated in table 1-1.

1-7. If the usual grounded emitter configuration is used for testing transistors, it results in a CRT plot of base or collector voltage versus collector current at the various drive levels. The connections can be interchanged to show curves for a grounded base configuration. For an FET, the curves show the gate or drain voltage versus the drain current; and for an SCR, gate or anode voltage versus anode current.

1-8. Collector Sweep Generator

1-9. The collector sweep generator provides the full wave rectified sine wave sweep voltages. See figure 1-1. Both positive and negative sweeps over the three ranges of voltages are programable. The fully adjustable peak values of 0-1000, 0-200 and 0-20 volts are controlled from the front panel. Two selectable series resistances, for programing, are also provided. These limit the maximum current to help protect the devices in the breakdown region. It also establishes the load line for the device under test.

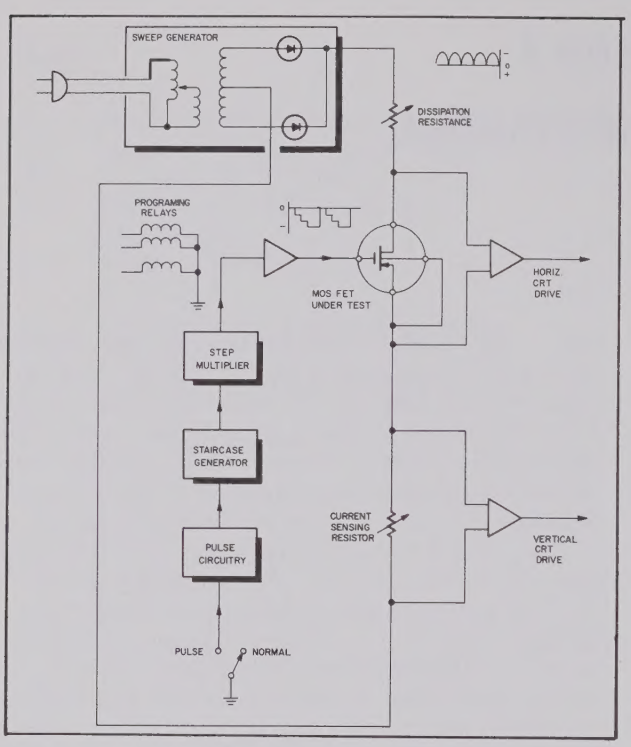


Figure 1-1. Model 6200B/P Basic Circuit

1-10. Base Step Generator

1-11. The driving source or input to the device under test is the base step generator. The step levels of the generator are determined by the range, multiplier and step number controls. The multiplier is a calibrated ten turn vernier which adds considerable convenience to the curve tracer. Not only does it allow precise selection of the drive levels, but it also simplifies Beta measurements. Full range, polarity and vernier settings are programable. In addition to the manual vernier setting, three other fixed multiplier values are programable, i.e., X1, X2 and X5.

1-12. Pulsed Operation

1-13. In addition to continuous voltage or continuous current drive, the 6200B/P provides "pulsed" operation. In this mode the drive is applied at the peak of the sweep and the device is only turned on for short periods of time. Thus the CRT shows the end points of the characteristic curves, and the power applied to the device is greatly reduced. Pulsed operation permits many devices to be checked without heat sinks and allows characteristics to be viewed at higher powers without exceeding safe dissipation levels. This mode of operation is also available as a programable function.

1-14. Horizontal and Vertical Deflection

1-15. The deflection system combines high stability with excellent sensitivity. The vertical sensitivity extends to 1 μA/division to accommodate the latest devices. Both the horizontal and vertical axis of the display can be inverted if desired. This permits PNP and "P" channel FET curves to be viewed in a normal manner instead of upside down. Again, each position on the vertical and horizontal controls may be operated by the companion unit Model 3509B.

1-16. Model 3509B Programer

1-17. In order to program the various functions of the curve tracer, a voltage is required to energize each function's relay. This voltage is supplied by the Curve Tracer to the Model 3509B. See figure 1-2. A +30 V DC supply provides the necessary voltage for these relays through the programer's special circuits. Each unit contains a six stage ring counter, a nine reed relay matrix, and two printed circuit diode voltage distribution matrix cards. The matrix cards provide the actual program wiring. The relay matrix in the 3509B interconnects the leads of the device being tested with the 6200B/P in the correct configuration for the particular test of the moment. The ring counter provides for the proper sequence (either manually or automatically) of tests. The time per test is controlled by a knob on the front panel. If desired, any test may be skipped. Thus, five complete tests of specific parameters may be quickly displayed without touching any controls on the 6200B/P. Programing is simple and fast through the use of the plug-in diode matrix. Extra plug-in cards are available at a small additional charge.

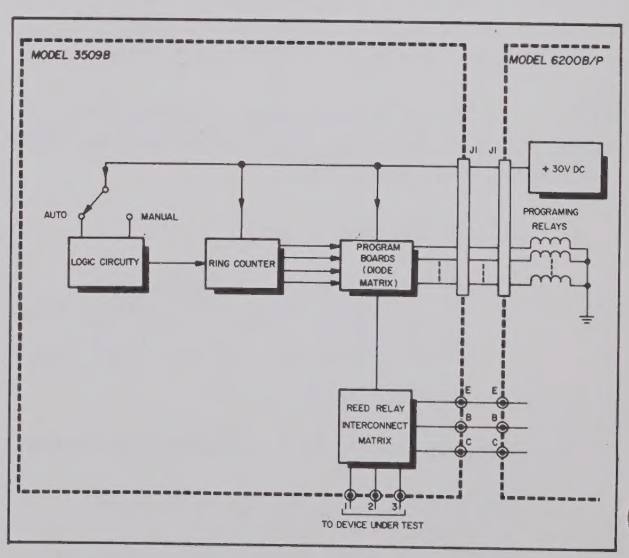


Figure 1-2. Model 6200B/P with Model 3509B Programer

1-18. ACCESSORIES AVAILABLE

1-19. The Model 6200B/P when ordered with 3509B Programer includes the following at no additional charge:

6200B/P–3509B interconnect cabling, dual transistor test fixture, power cable, one set of programing cards (less diodes and program), and one instruction manual.

1-20. The following accessories are available at extra cost:

Dual Transistor Test Fixture (P/N6620-30)
High Speed Transistor Test Jig (P/N3401-1560)
High Speed Diode Test Jig (P/N3401-1570)
Long Lead Transistor Test Jig (P/N3401-1580)
Instruction Manual (P/N6705-1591)
Extender Card (P/N6950-30

1-21. SPECIFICATIONS

1-22. Tables 1-1 and 1-2 list specifications for the Model 6200B/P and Model 3509B respectively.

Table 1-1. Model 6200B/P Specifications

COLLECTOR SWEEP GENERATOR	
Sweep Ranges ♦	0 to 1000 V, 100 mA 0 to 200 V, 500 mA. 0 to 20 V, 5 A.
Sweep Frequency	Twice power line frequency.
Polarity*	Positive or negative.
Overload Protection	Circuit breaker, with front panel reset.
Collector Series Resistance*	Selectable 3 Ω to 1 M in eleven steps (two programable values).
BASE STEP GENERATOR	
Voltage Range*†	Continuously variable, 10 mV to 35 V.
Current Range*†	Continuously variable, 100 nA to 500 mA.
Continuous Sweep Duty Cycle	100%
Pulse Mode Duty Cycle*	Less than 10%
Number of Steps	0 to 10. First and last steps selected independently.
Polarity*	Positive or negative.
VERTICAL DISPLAY	
Collector Current*	1 μA/division to 500 mA/division.
HORIZONTAL DISPLAY	
Collector Voltage*	10 mV/division to 100 V/division.
Base Voltage*	100 mV/division, 200 mV/division, 500 mV/division.

* Each function fully programable.
♦ Range setting is programable.
† Multiplier vernier setting and/or fixed values X1, X2, X5 (internal).

Table 1-1. Model 6200B/P Specifications (Continued)

POWER		
Voltage	115/230 ±10%	
Frequency	50-60 Hz.	
DIMENSIONS	Height:	9¼ inches (23.5 cm).
	Width:	16¾ inches (42.5 cm).
	Depth:	19½ inches (49.5 cm).
WEIGHT	50 lbs. (33.6 kg)	

Table 1-2. Model 3509B Specifications

GENERAL		
	This unit will program the Model 6200B/P Curve Tracer to automatically display up to five tests on a single device.	
Number of Tests	1 to 5	
Number of Output Lines	50	
Device Lead Connection	The connections between the leads of the device under test and the 6200B/P Curve Tracer are controlled by a reed relay matrix in the 3509B.	
Modes of Operation	Manual or automatic advance selected by front panel switch. Also can be remotely advanced by foot switch.	
Test Time (Automatic Mode)	Adjustable from approximately 70 to 800 milliseconds per test, from front panel.	
Power	From the Curve Tracer.	
MECHANICAL		
Dimensions	Height:	5¼ inches (13.3 cm).
	Width:	16¾ inches (42.5 cm).
	Depth:	19½ inches (49.5 cm).
Weight	14 lbs. (6.6 kg)	

Section II
Installation

2-1. INTRODUCTION

2-2. This section contains instructions for initial installation and inspection of the Model 6200B/P Programable Curve Tracer. Reshipment instructions are also included in case the instrument must be returned to Fairchild Instrumentation.

2-3. UNPACKING

2-4. Before accepting the instrument from the shipper, inspect the crated instrument for external damage. Any sign of such damage must be called to the attention of the shipper and noted on the receiving receipt. Do not proceed with unpacking until instructed to do so by the authority of the insuring agency.

2-5. MECHANICAL INSPECTION

2-6. As soon as the equipment is unpacked, inspect the instrument for damage in shipment, check for scratches, dents, damaged knobs or connectors. Remove the top cover plate and inspect the plug-in boards. They should be firmly seated in their sockets. If there is evidence of damage, do not use the instrument until it has been inspected by the insurance investigator.

2-7. POWER REQUIREMENTS

2-8. The Model 6200B/P is designed to operate from a 115 V AC, 3-wire, single phase 50-60 Hz power source. Do not connect the instrument to a power source with incorrect voltage or inadequate current rating.

2-9. To protect operating personnel, the National Electronic Manufacturing Association (NEMA) recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the cabinet of the instrument. The offset pin on the power cable three-prong connector is the ground wire.

2-10. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the pigtail on the adapter to a suitable ground.

2-11. PERFORMANCE CHECK

2-12. The Model 6200B/P is completely aligned, calibrated, and checked before shipment and is ready for use upon receipt. The performance check in paragraph 5-6 may be used to ensure that all components and circuits are in operating condition when the instrument is first installed.

2-13. RESHIPMENT

2-14. All sales are made F.O.B. point of shipment. Seller's title passes to Buyer and Seller's liability as to delivery ceases upon making delivery of material purchased hereunder to carrier at shipping point in good condition; the carrier acting as Buyer's agent. All claims for damages must be filed with the carrier.

2-15 When an instrument is to be returned for service or repair, consult your nearest Systron-Donner engineering representative for shipping instructions. Such an instrument should be properly identified and tagged to facilitate handling and identification upon receipt at the repair center or factory.

Section III
Operation

3-1. INTRODUCTION

3-2. There are many diverse applications of the Model 6200B/P. The instrument may be used to test any device that is responsive to curve trace analysis, and it is well suited to testing low-power devices. Simple-to-operate controls are arranged in logical order on the front panel. This section discusses each control, its function, and some of the instrument's applications.

3-3. CONTROLS

3-4. Figure 3-1 (in two parts) describes the controls on the front panel of the 6200B/P. Figure 3-2 shows the rear panel controls and connectors.

3-5. OPERATING INSTRUCTIONS

3-6. The instructions that follow give general instructions for testing the characteristics of an unknown device and for the conduct of typical tests.

3-7. Testing Unknown Devices

3-8. Caution must be taken to protect a device of unknown characteristics when it is tested on the Model 6200B/P. The operator must be careful to ensure that the transistor's collector dissipation and current ratings, and collector-to-emitter voltage ratings are not exceeded.

3-9. The procedure for testing unknown devices is outlined in figure 3-3. It is assumed that the operator knows whether the device is PNP or NPN.

3-10. Typical Tests

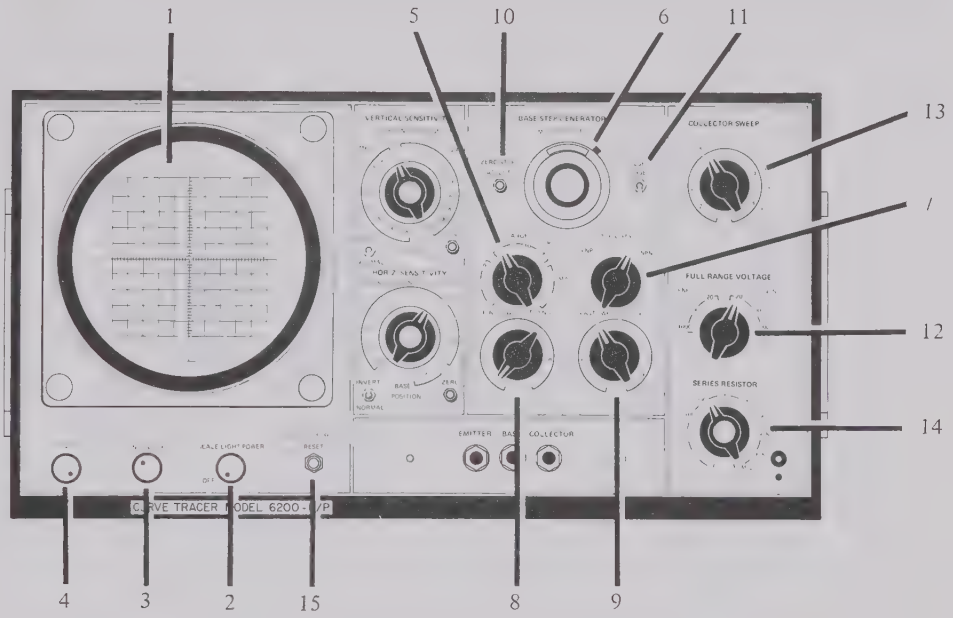
3-11. Semiconductor devices normally tested on the Model 6200B/P Curve Tracer fall into six categories: diodes, conventional PNP and NPN bipolar transistors, junction field effect transistors, metal oxide semiconductor field effect transistors, silicon controlled rectifiers, and unijunction transistors. In figures 3-5 through 3-9, general instructions are given on how to use the Model 6200B/P to exhibit the characteristics of these devices. Waveforms obtained from tests on typical units in each category are also shown.

3-12. OPERATION WITH MODEL 3509B PROGRAMER

3-13. Instructions for using the Model 6200B/P with the Model 3509B Programer to automatically display up to 5 tests on a single device are fully detailed in Appendix A of this manual.

3-14. PRODUCTION TEST FORM

3-15. Form 8320-52 (see figure 3-4) is a production aid provided by Fairchild Instrumentation Marketing Services Department to assist production workers in setting up tests on a customer's Model 6200B/P. Pads of Form 8320-52 are available at a nominal cost by writing to Fairchild Instrumentation.



1. Cathode ray tube screen and graticule.

2. SCALE LIGHT/POWER control:

   a. Applies primary power to instrument.

   b. Controls intensity of graticule light.

3. INTENSITY control adjusts brightness of trace.

4. FOCUS control adjusts clarity of trace.

5. RANGE switch:

   a. Sets basic current value-per-step of base step generator. Step values are .1, 1, 10, and 100 μA; 1 and 10 mA.

   b. Sets basic voltage value-per-step of base step generator. Step values are .01, .1 and 1 V.

6. BASE STEP GENERATOR MULTIPLIER control, used in conjunction with RANGE switch, programs base step generator value-per-step. The multiplier is graduated from 1 to 11.

7. POLARITY switch selects polarity of base step generator.

8. FIRST SWEEP STEP NO. switch selects first step of base step generator.

9. LAST SWEEP STEP NO. switch selects last step of base step generator.

10. ZERO STEP ADJUST preset control sets zero step of base step generator.

11. PULSED BASE/NORMAL switch:

    a. Selects continuous base drive in NORMAL position.

    b. In BASE PULSED position limits base drive to time when collector sweep voltage is near maximum. This produces a duty cycle of less than 10%.

12. FULL RANGE VOLTAGE switch selects polarity and full scale value of collector sweep voltage.

13. COLLECTOR SWEEP VOLTAGE control sets collector voltage value to any level between 0% and 100% of FULL SCALE VOLTAGE setting.

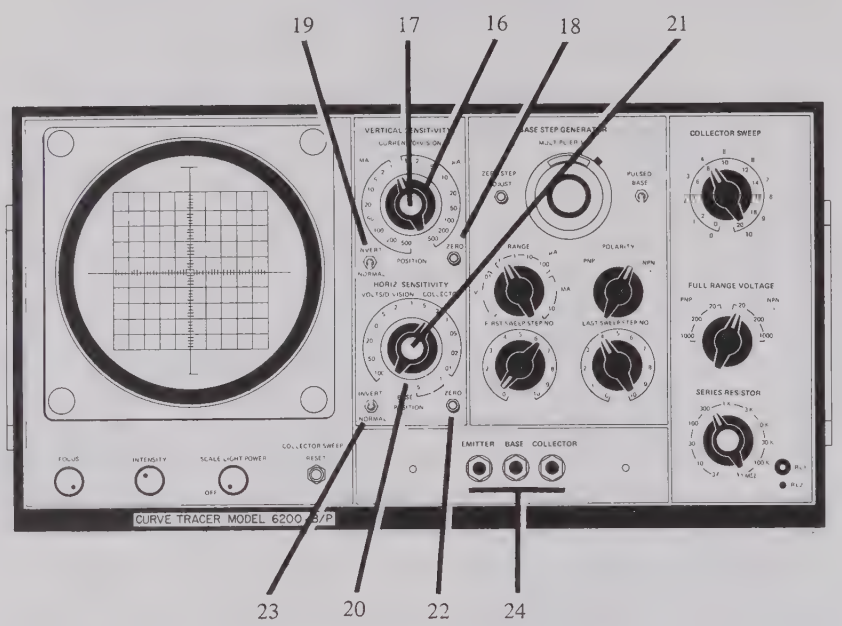
14. SERIES RESISTOR switch:

    a. RL1 (outer knob) selects value of current limiting resistor in collector circuit. Control is operative in LOCAL and REMOTE programing modes.

    b. RL2 (inner knob) selects a value of current limiting resistance in collector circuit. Control is operative only in REMOTE programing mode.

15. COLLECTOR SWEEP RESET switch controls collector sweep overload circuit breaker.

Figure 3-1. Model 6200B/P Front Panel Description



16. VERTICAL SENSITIVITY switch selects sensitivity of Y-axis presentation showing collector current. Sensitivity settings per graticule division run in a 1-2-5 sequence from 1 μA to 500 mA.

17. VERTICAL POSITION control positions trace vertically on CRT screen.

18. ZERO switch grounds vertical amplifier input.

19. NORMAL/INVERT switch:

    a. Provides normal display of vertical presentation in NORMAL position.

    b. Inverts vertical display in INVERT position.

20. HORIZ. SENSITIVITY switch:

    a. COLLECTOR positions set sensitivity of X-axis presentation, showing voltage applies to collector of transistor under test. Sensitivity settings per graticule division run in 1-2-5 sequence from .01 to 100 volts.

    b. BASE positions set sensitivity of X-axis presentation, showing voltage applied to base of transistor under test. Sensitivity settings per graticule division are: 0.1, 0.2, and 0.5 V.

21. HORIZ. POSITION control positions trace vertically on screen.

22. ZERO switch grounds input of horizontal amplifier.

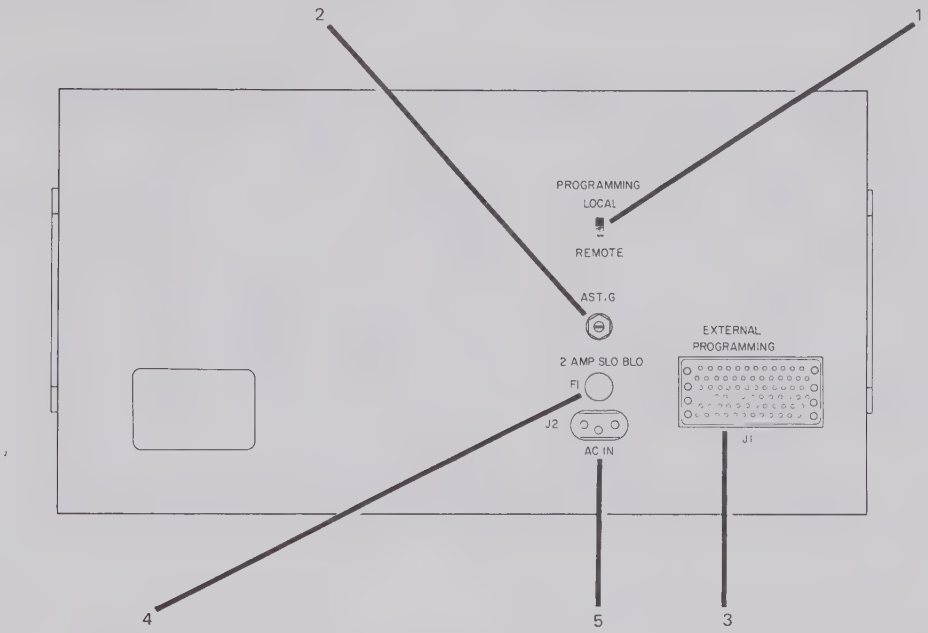
23. NORMAL/INVERT switch:

    a. Provides normal display of vertical presentation in NORMAL position.

    b. Inverts horizontal display in INVERT position.

24. C-B-E terminals permit device under test to be connected to instrument.

Figure 3-1. Model 6200B/P Front Panel Description (Continued)



1. PROGRAMING switch:

   a. Permits control of Model 6200B/P with front panel controls when set to LOCAL.

   b. Connects Model 3509B Programer data to Model 6200B/P when set to REMOTE.

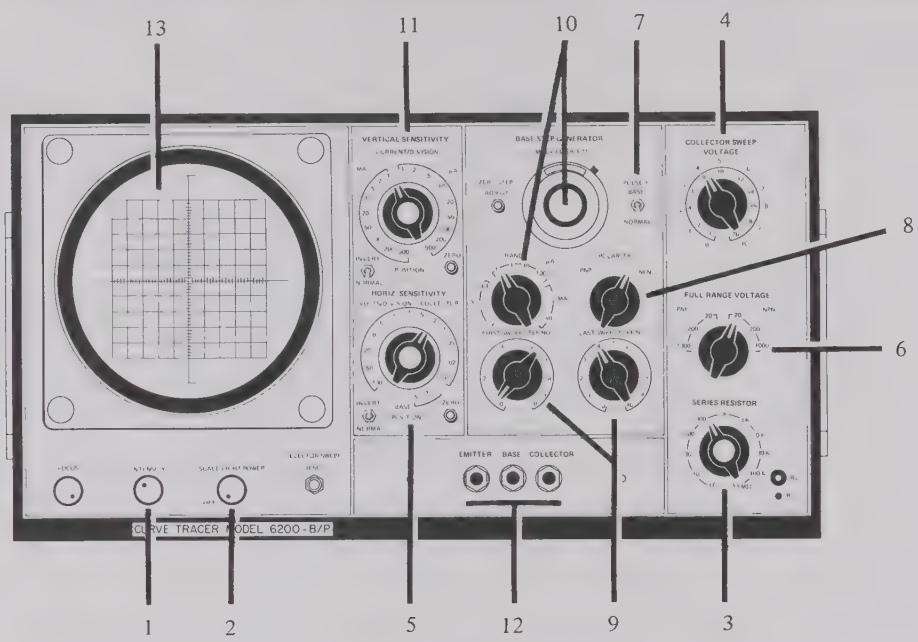
2. ASTIG control adjusts clarity of trace.

3. EXTERNAL PROGRAMING jack J1 is connection for cable from Model 3509B Remote Programer.

4. Fuse F1 is in AC input circuit of instrument. Replacement value is 2 Amp slow-blow for 115 V AC operation, 1 Amp for 230 V AC operation.

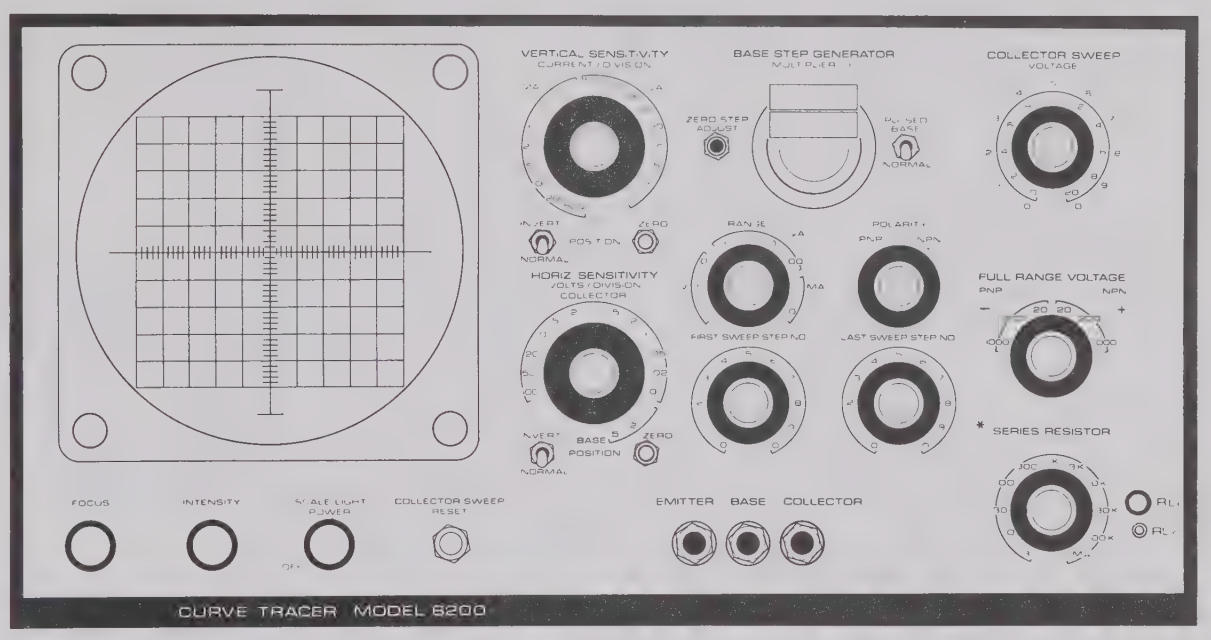
5. AC IN jack (J2) is receptacle for AC power cord.

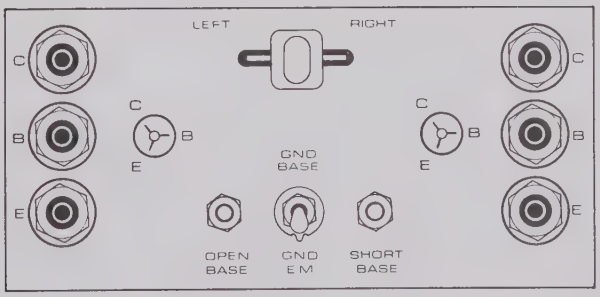
Figure 3-2. Rear Panel Description, Model 6200B/P



1. Turn INTENSITY control to mid-scale. This prevents damage to the screen when power is applied.
2. Turn POWER ON. Allow instrument to warm up.
3. Set SERIES RESISTOR to 1 MΩ.
4. Turn COLLECTOR SWEEP VOLTAGE control to 0 V (fully counter-clockwise).
5. Set HORIZ. SENSITIVITY control to 2 V/div.
6. Set FULL RANGE VOLTAGE amplitude to 20 V, appropriate polarity.
7. Set PULSED BASE/NORMAL switch to NORMAL.
8. Set POLARITY switch to appropriate position for NPN or PNP transistor.
9. Select FIRST SWEEP STEP NO. and LAST SWEEP STEP NO. as required.
10. Set RANGE and MULTIPLIER adjustments to minimum.
11. Set VERTICAL SENSITIVITY to 1 mA/div.
12. Connect device under test to test terminals.
13. Observe display and adjust controls one at a time, increasing COLLECTOR SWEEP VOLTAGE, Base RANGE, and MULTIPLIER controls while reducing Collector SERIES RESISTOR. It may be necessary to readjust VERTICAL and HORIZ. SENSITIVITIES to obtain desired display.
14. A family of curves should now be displayed on CRT screen. Adjust controls for desired test conditions.

Figure 3-3. Unknown Device Test





*SERIES RESISTOR control is a concentric switch on Model 6200B/P only

Test Type: _____

Test Condition: _____

Test Limits: _____

Figure 3-4. Production Test Form, Models 6200B and 6200B/P

TEST

Display the forward and reverse conduction characteristics of an FD300 silicon diode.

TECHNIQUE:

To make the diode conduct in the forward direction, bias with the sweep generator in the 6200B, (see figure a) selecting the generator polarity that gives conventional current flow through the diode. Insert collector series resistor to limit current through the diode. The forward voltage drop across the diode will be in the range of 0.2 to 2.0 V, depending on the current through it. To measure the voltage applied across the diode in the reverse direction before it breaks down, reverse the diode physically in the test socket, or reverse the polarity of the sweep generator. The reverse breakdown voltage is generally 25 to 500 V, however, higher voltage units are available.

RESULTS:

The forward conduction characteristic of an FD300 silicon diode is shown in figure a). For this particular device,

V_F = .70 V at I_F = 5 mA.

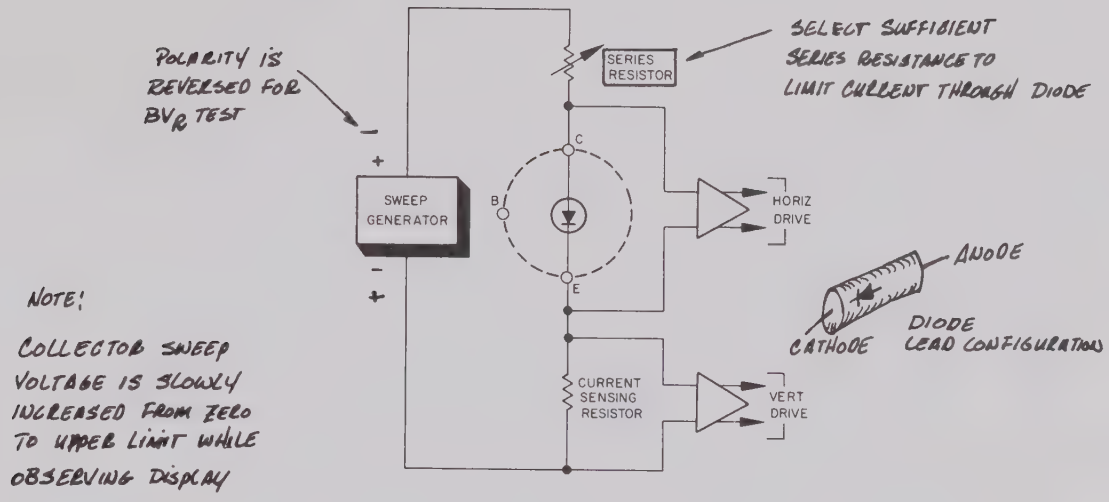
Figure c) shows the reverse breakdown characteristic for the particular FD300 silicon diode under test. It is clear that:

BV = 260 V at I_R = 100 μA.

Table 1. Manufacturer's Specifications: FD300 Silicon Diode (25°C Free Air Temperature)

SYMBOL	CHARACTERISTIC	MINIMUM	TYPICAL	MAXIMUM	TEST CONDITIONS
V_F	Forward Voltage			.75 V	I_F = 5 mA
BV	Breakdown Voltage	150 V			I_R = 100 μA

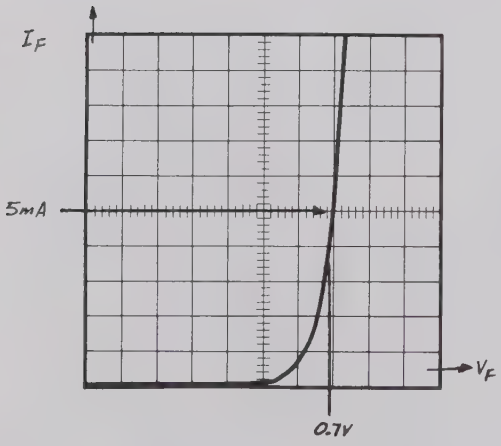
Figure 3-5a. Diode Tests



Full Range Voltage: +20

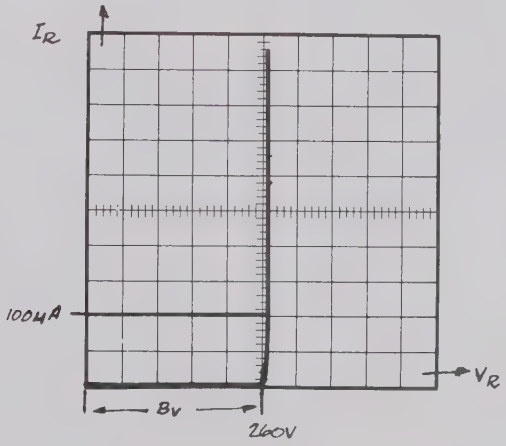
Full Range Voltage: -1000 V

Figure a) Curve Tracer Setup for Testing Forward Conduction of a Diode



Vertical: 1 mA/div
Horizontal: 0.1 V/div

Figure b) Forward Conduction Characteristic of an FD300 Silicon Diode



Vertical: 50μA/div (inverted)
Horizontal: 50 V/div (inverted)

Figure c) Reverse Breakdown in an FD300 Silicon Diode

Figure 3-5b. Diode Tests

TEST

Measure h_{FE}, $V_{CE(Sat)}$, and breakdown voltages BV_{CEO} and BV_{CES} for a 2N2905 PNP transistor.

TECHNIQUE:

The test setup for measuring h_{FE} and $V_{CE(Sat)}$ in a PNP transistor is given in figure a). Note that polarities of both generator outputs are negative in the PNP test setup.

The common emitter forward current transfer ratio (h_{FE}) is defined as:

$$h_{FE} = \frac{I_C}{I_B} \qquad \text{(at specified } V_{CE}\text{)}.$$

To derive h_{FE} (dc current gain), measure the collector current produced by a base current at the specified collector voltage. This characteristic is shown in figure b)

Saturation voltage $V_{CE(Sat)}$ is defined as the collector voltage at which collector current becomes essentially independent. To measure saturation voltage select the appropriate scale factor for horizontal collector volts. The saturation region is clearly defined in the bending area of the curve in figure c).

The method of testing breakdown voltage such as BV_{CEO} (the collector to emitter breakdown voltage with base open) is similar to that discussed for testing a diode. See figure d). Typical breakdown voltage curves for a 2N2905 transistor are shown in figure e). Note that both breakdown voltage characteristics are shown in one photograph. This was accomplished using a double exposure technique with a scope camera.

RESULTS:

h_{FE} = 167.

$V_{(Sat)}$ = -.22 V at I_C = 150 mA, I_B = 15 mA

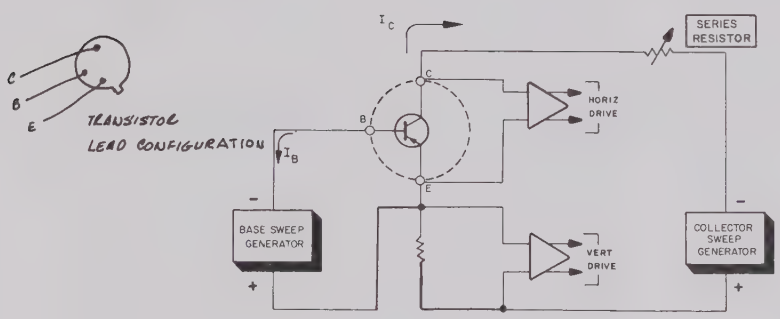
BV_{CEO} = 58 V at I_C = 10 mA, I_B = 0

BV_{CES} = 64 V at 5 mA

Table 1. Manufacturer's Specifications: 2N2905 PNP Transistor

SYMBOL	CHARACTERISTIC	MINIMUM	TYPICAL	MAXIMUM	TEST CONDITIONS
h_{FE}	DC Current Gain	75			I_C = 10 mA V_{CE} = -10 V
$V_{CE(Sat)}$	Collector Saturation Voltage			-0.4 V	I_C = 150 mA I_B = 15 mA
BV_{CEO}	Collector to Emitter Breakdown Voltage (Base Open)	-40 V			I_C = 10 mA I_B = 0
BV_{CES}	Collector to Emitter Breakdown Voltage (Base Shorted to Emitter)				I_C = 5 mA V_{BE} = 0

Figure 3-6a. Transistor Tests



COLLECTOR

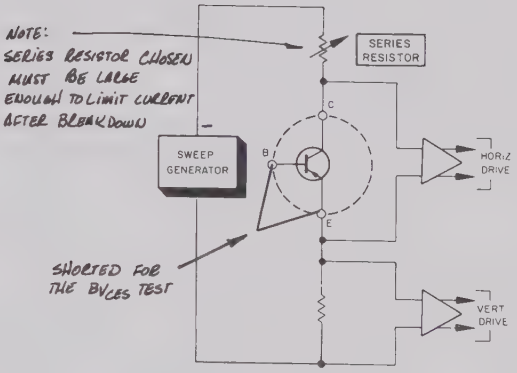
Full Range
Voltage: 20 - PNP

Collector
Sweep
Voltage: 10

BASE

Range: 10 μA/step
Multiplier: 5.99
First Step: 0
Last Step: 1
Polarity (-)

Figure a) PNP Transistor Test Setup



COLLECTOR

Full Range
Voltage: 20 - PNP

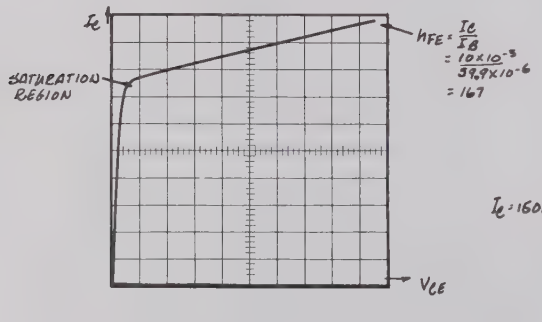
Collector
Sweep
Voltage: 10

BASE

Range: 10 mA/step
Multiplier: 1.5
First Step: 1
Last Step: 1
Polarity (-)

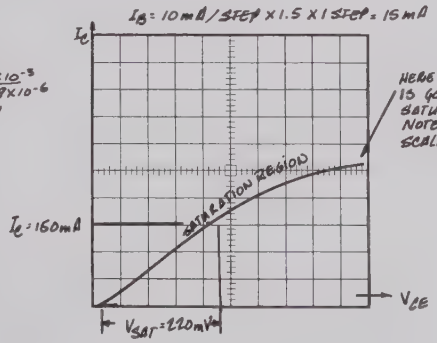
Full Range
Voltage: -200

Open base for BV_{CEO} test by holding down OPEN BASE pushbutton.



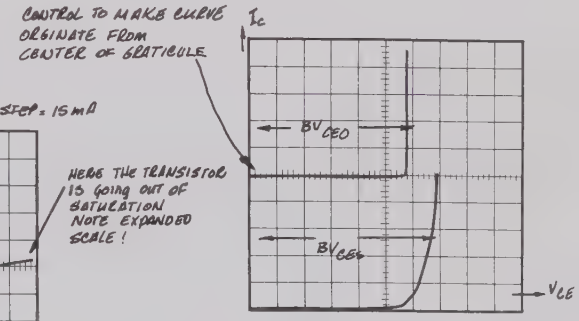
Vertical: 1 mA/div (inverted)
Horizontal: 1 V/div (inverted)

Figure b) Collector Characteristic


$I_B = 10mA/STEP \times 1.5 \times 1 STEP = 15mA$
I_C
HERE THE TRANSISTOR IS GOING OUT OF SATURATION NOTE EXPANDED SCALE!
$I_C = 150mA$
SATURATION REGION
$V_{SAT} = 220mV$
V_{CE}

Vertical: 50 mA/div (inverted)
Horizontal: 0.05 V/div (inverted)

Figure c) Saturation in a 2N2905



Top: BV_{CEO}
Vertical: 5 mA/div (inverted)
Horizontal: 10 V/div (inverted)

Bottom: BV_{CES}
Vertical: 2 mA/div (inverted)
Horizontal: 10 V/div (inverted)

Figure 3-6b. Transistor Tests

TEST

Measure exact values of:

a) drain current at zero-gate voltage (I_{DSS}).

b) drain-gate breakdown voltage (BV_{DGO}) for a U1283 N-channel junction field effect transistor.

TECHNIQUE:

Figure a) shows the test setup for a N-channel depletion type junction field effect transistor.

I_{DSS} is the current that flows through a depletion type junction field effect transistor with 0 V applied to gate.

Figure b) shows I_D versus V_{DS} for 10 steps of gate voltage. The highest curve corresponds to I_{DSS}.

Pinch off-voltage (V_p) of an FET is the gate-to-source voltage that must be applied to reduce the drain current to zero. The lowest curve on figure c) corresponds to approximately pinch-off.

To obtain the characteristic curve for drain to gate breakdown voltage as shown in figure c), the gate lead is inserted in the emitter terminal and the source is left open while the collector sweep is applied to the drain lead.

RESULTS:

BV_{GSS} = 86 V at I_G = 10 μA

I_{DSS} = .5 mA at V_{DS} = 5 V, V_{GS} = 0 V

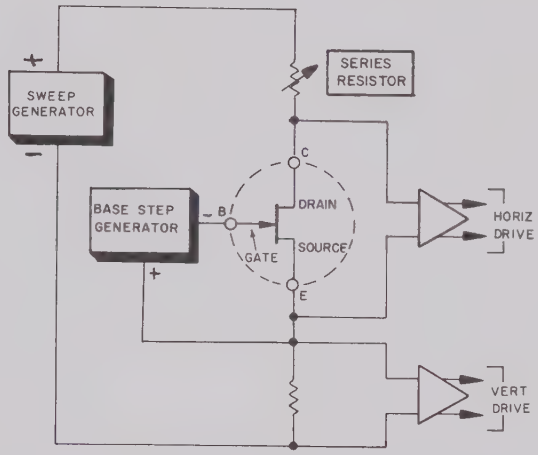
V_P = 2.03 V at V_{DS} = 0 V, I_D = 1 μA

Table 1. Manufacturer's Specifications: U1283 N-Channel Junction Field Effect Transistor

SYMBOL	CHARACTERISTIC	MINIMUM	TYPICAL	MAXIMUM	TEST CONDITIONS
I_{DSS}	Drain Current at Zero Gate Voltage	1 mA		10 mA	V_{DS} = -5.0 V, V_{GS} = 0 V
BV_{DGO}	Drain-Gate Breakdown Voltage		50 V		I_D = 1 μA, I_S = 0

Figure 3-7a. FET Tests

FET LEAD CONFIGURATION



NOTE:
INCREASE COLLECTOR SWEEP VOLTAGE SLOWLY FROM 0 TO UPPER LIMIT WHILE OBSERVING DISPLAY

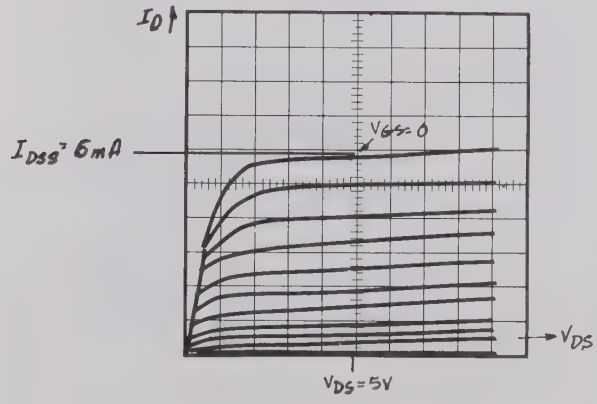
Collector
Sweep Voltage: +20

Range: 0.1 V/step
Multiplier: 2.03
Polarity: (-)
First Step: 0
Last Step: 10

Collector
Sweep Voltage: +200

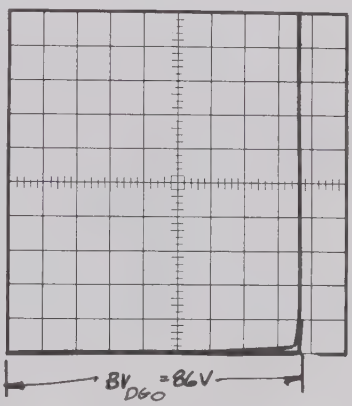
Figure a) Test Setup for a Junction Field Effect Transistor

$V_p = 0.1V/STEP \times 2.03 \times 10\ STEPS = 2.03V$



Vertical: 1 mA/div
Horizontal: 1 V/div

Figure b) Conduction Characteristics



Vertical: 1 μA/div
Horizontal: 10 V/div

Figure c) Drain-Gate Breakdown Voltage

Figure 3-7b. FET Tests

TEST

Verify the following parameter specifications given for an 2N4120 MOS FET.

TECHNIQUE:

The MOS FET is connected as shown in figure a). Note that the substrate is connected to the source. As shown in figure b), the characteristic curves originate in the lower left hand corner of the graticule even though 2N4120 is a P-type device. This is possible by using the horizontal and vertical INVERT switches on the Model 6200B.

Y_{fs}, gate to Drain Transconductance, is defined as:

$$Y_{fs} = \frac{\Delta I_D}{\Delta V_{GS}} \quad \text{at constant V.}$$

Figure b) shows that when $V_{DS} = V_{GS} = -15$ V, a 1 V change causes a 750 μA change in I_D.

Therefore:

$$Y_{fs} = \frac{750}{1} \times 10^{-6} = 750\,\mu\text{mhos.}$$

The gate threshold voltage, V_{GST}, is reached when the gate voltage level with respect to the source voltage becomes great enough to allow conventional current to flow from the source to the drain lead. The characteristic shown in figure c) is obtained by varying the multiplier potentiometer and applying one step of base voltage sufficient to drive the device into conduction. The threshold is reached when $V_{GS} = 5.41$.

RESULTS:

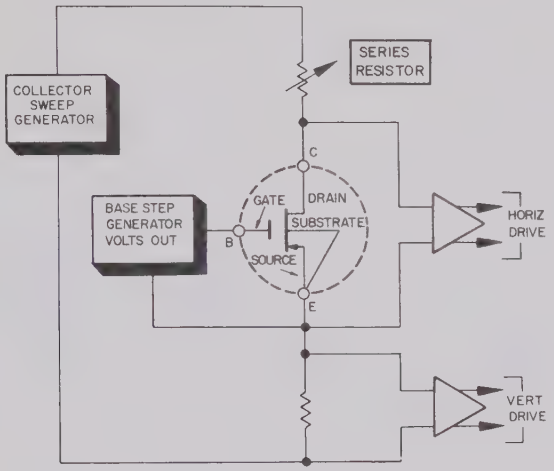
$Y_{fs} = 750\,\mu$mhos

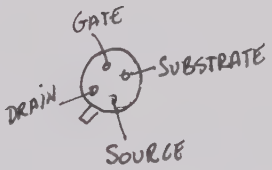
$V_{GS} = 5.41$

Table 1. Manufacturers Specifications: 2N4120 MOS FET (25°C Free Air Temperature)

SYMBOL	CHARACTERISTIC	MINIMUM	TYPICAL	MAXIMUM	TEST CONDITIONS
Y_{fs}	Gate to Drain Transconductance	700 μmhos		800 μmhos	$V_{GS} = V_{DS} = -15$ V
$V_{GS(th)}$	Gate Threshold Voltage	-3.0 V	-4.7 V	-6.0 V	$I_D = 10\,\mu$A

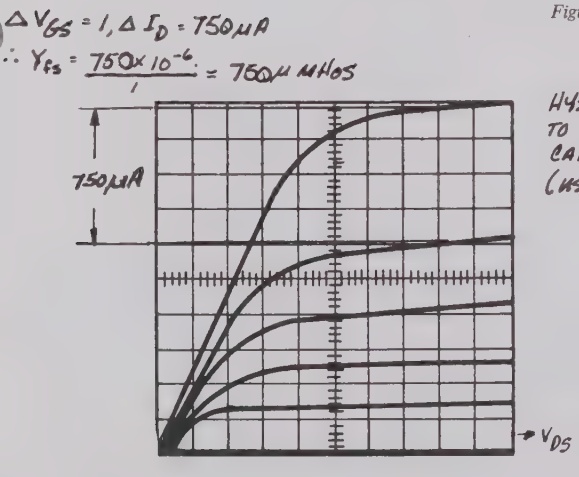
Figure 3-8a. MOS FET Tests





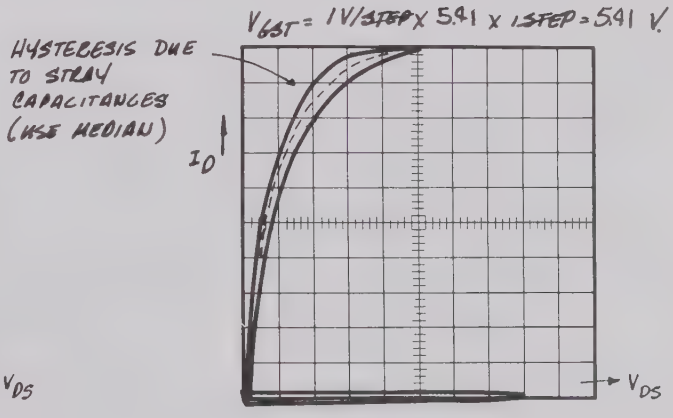
COLLECTOR		BASE		COLLECTOR		BASE	
Full Range Voltage:	−20	Range:	1 V/step	Full Range Voltage:	−20	Range:	1 V/step
		Polarity:	(-)			Polarity:	(-)
		Multiplier:	1.0			Multiplier:	5.41
		First Step:	5			First Step:	0
		Last Step:	10			Last Step:	1

Figure a) MOS FET Test Setup



Vertical: 200 μA/div (inverted)
Horizontal: 2 V/div (inverted)

Figure b) Conduction Characteristics



Vertical: 1 μA/div (inverted)
Horizontal: 2 V/div (inverted)

Figure c) Gate Threshold Voltage

Figure 3-8b. MOS FET Tests

TEST

Verify the specifications listed below for a 2N3276 SCR.

TECHNIQUE:

Forward and reverse breakdown characteristics are measured with the SCR's gate lead open. The anode of the device is connected to the COLLECTOR terminal and the cathode is connected to the EMITTER terminal. The collector sweep voltage then is increased until breakdown is observed on the CRT display. Forward and reverse breakdown characteristics are both shown in figure a). Display of both characteristics on one photo was made possible by a double exposure technique using a scope camera. To determine V_{GT} at rated voltage from anode to cathode, the SCR is connected to the test setup shown in figure b). The collector sweep voltage is turned up to 400 volts. First and last step numbers are set to 0 and 1 respectively; then the base step RANGE is set to approximately the correct range.

The MULTIPLIER adjustment is increased then until minimum gate voltage is applied to fire the device. The gate firing voltage for the device being tested is V_{GT} = RANGE x MULT x STEP NUMBER.

Figure c) shows the device being triggered into conduction. Note in the lower left hand of the photo that the particular device under test turns off when anode current drops below 1.2 mA. Therefore, the holding current is: I_H = 1.2 mA. Without the pulse capability of the Model 6200B, it is impossible to make this measurement accurately on a curve tracer. In the normal display mode, the gate drive, which is applied during the entire collector sweep, produces an erroneous reading. The ON voltage is measured across the anode-cathode terminals of the device while it is under conduction. ON voltage at 2.2 A is shown in figure d).

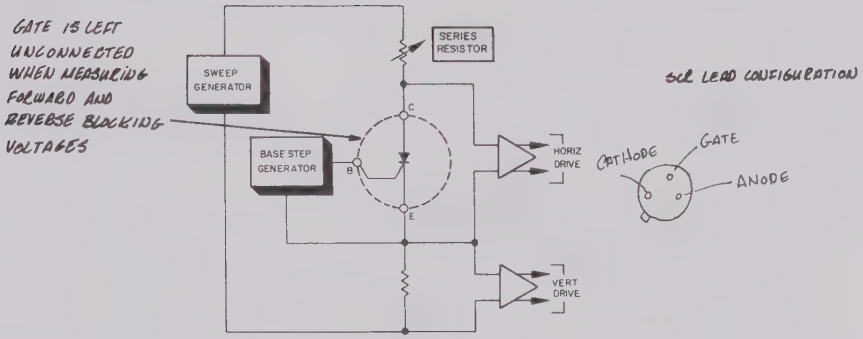
RESULTS:

V_{FX} = 475 V V_{RO} = 475
V_{GT} = .54 V I_H = 1.2 mA
V_F = 1.2 V at I_F = 2.2 A

Table 1. Manufacturer's Specifications: 2N3276 SCR

SYMBOL	CHARACTERISTIC	MINIMUM	TYPICAL	MAXIMUM	TEST CONDITIONS
V_{FX}	Forward Blocking Voltage	400 V			I_{FX} = 10 μA
V_{RO}	Reverse Blocking Voltage	400 V			I_{RO} = 10 μA I_G = 0
V_{GT}	Gate Trigger Voltage	0.1 V	0.3 V		V_{AK} = 400 V
I_H	Holding Current		0.7 mA	2.0 mA	I_G = 0 R_K = 1 K
V_F	On Voltage		1.5 V	1.8 V	I_F = 2.2 A

Figure 3-9a. SCR Tests

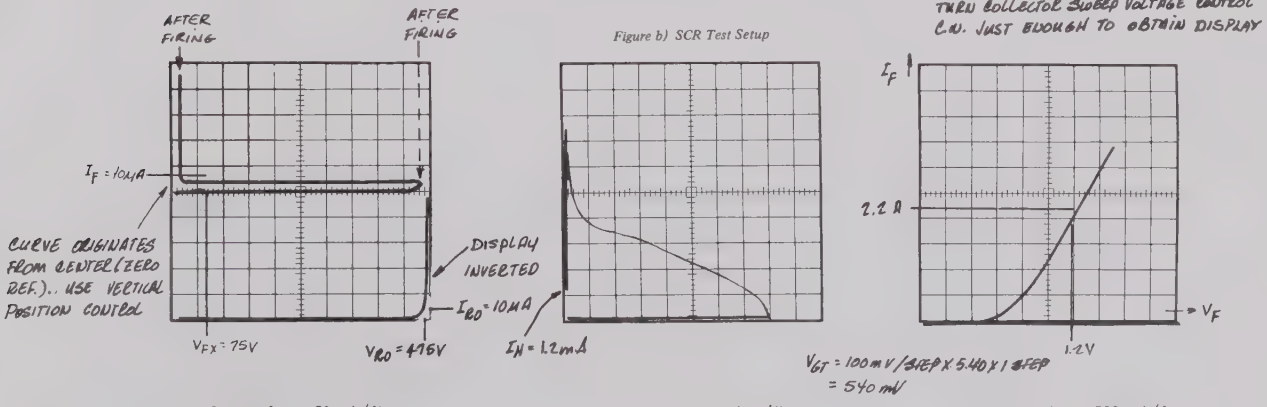


TOP: V_{FX}
Full Range
Voltage: +1000

BOTTOM: V_{RO}
Full Range
Voltage: -1000

SWEEP GENERATOR		STEP GENERATOR			
Full Range Voltage:	+1000	Range:	100 mV/step	Full Range Voltage:	+20 V
		Polarity:	(+)		
		Multiplier:	5.40		
Collector Sweep Voltage:	400	First Step:	0	Series Resistor:	10 Ω
		Last Step:	1		
		Mode:	Pulsed		

Figure b) SCR Test Setup



Vertical:	20 μA/div	Vertical:	1 mA/div	Vertical:	500 mA/div
Horizontal:	50 V/div	Horizontal:	50 V/div	Horizontal:	0.2 V/div

Figure a) Forward and Reverse Blocking Voltages

Figure c) Firing Characteristics

Figure d) Conduction Characteristics

Figure 3-9b. SCR Tests

TEST:

Measure the parameters listed below to verify the manufacturer's specifications for a 2N2646 unijunction transistor.

TECHNIQUE:

Test configuration for measuring interbase resistance is shown in figure a).

The emitter lead is left unconnected, and the sweep generator is used to establish V_{BB}.

The conduction characteristics of the unijunction are measured by connecting the device to the Model 6200B as shown in figure c).

Notice that the bias between Base 1 and Base 2 of the unijunction is supplied by the base step generator in the curve tracer. With the 6200B, one single step can be selected by use of the multiplier and range switches. Any bias level up to 33 V can be applied. The amount of bias can be adjusted at the front panel of the 6200B. The dc bias across the 2N2646 in figure d) is 1 V/step x 2.5 x 10 steps = 25 V.

The peak-point emitter voltage is the maximum voltage that can be applied between Base 2 and the emitter of the unijunction before the device goes into conduction. This value is clearly indicated on the horizontal axis of figure d) for the condition of 25 Vdc bias between Base 1 and Base 2.

V_V and I_V are the minimum voltage and current that will keep the unijunction turned on.

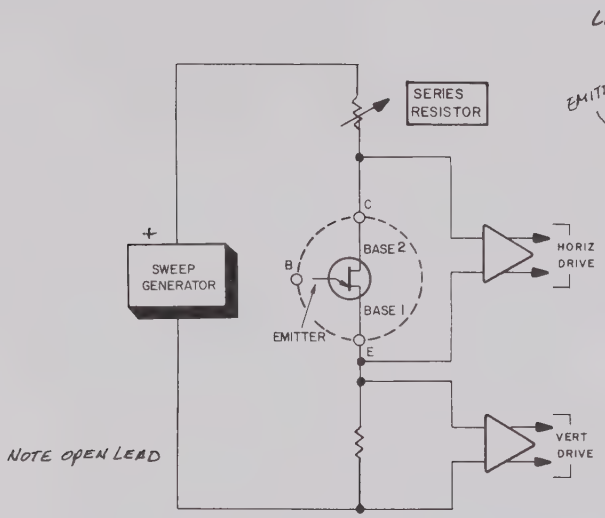
RESULTS:

R_{BB}	=	8.88 kΩ at V_{BB}	=	3 V.
		I_E	=	0
η	=	.64 at V_{BB}	=	25 V.
V_P	=	16 at V_{BB}	=	25 V.
V_V	=	5 at V_{BB}	=	25 V.
I_V	=	7 mA at V_{BB}	=	25 V.

Table 1. Manufacturer's Specifications: 2N2646 Unijunction Transistor

SYMBOL	CHARACTERISTIC	MINIMUM	TYPICAL	MAXIMUM	TEST CONDITIONS
R_{BB}	Interbase Resistance	4.7 kΩ		9.1 kΩ	V_{BB} = 3 V I_E = 0
η	Intrinsic Stand-off Ratio	.56		.75	V_{BB} = 25 V
V_P	Peak Point Emitter Voltage		10 V		V_{BB} = 25 V
V_V	Valley Voltage		2.5 V		V_{BB} = 25 V
I_V	Valley Current		5 mA		V_{BB} = 25 V

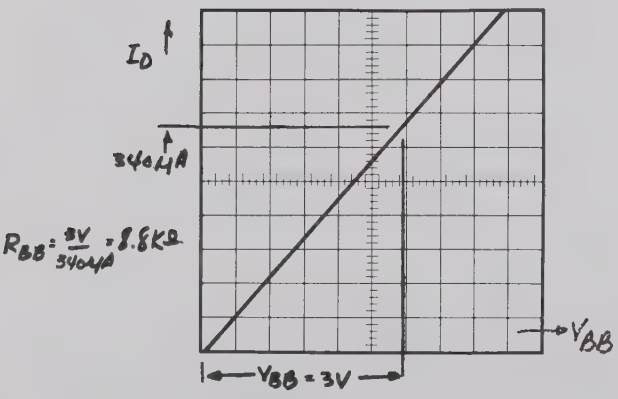
Figure 3-10a. Unijunction Transistor Tests



Full Range Voltage: 20 + NPN

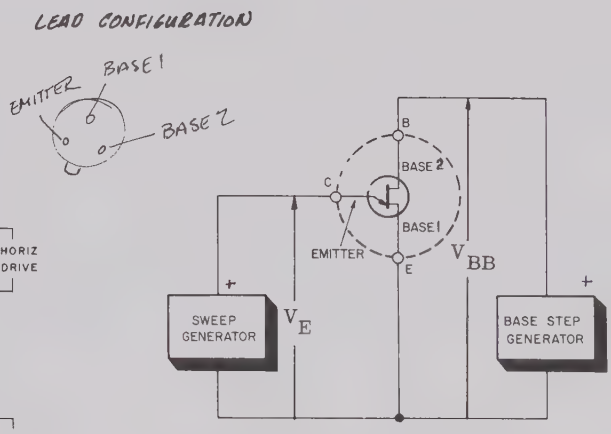
Collector Sweep Voltage: 5

Figure a) Test Setup for Measuring Interbase Resistance



Vertical: 50 μA/div
Horizontal: 0.5 V/div

Figure b) Interbase Resistance Characteristics

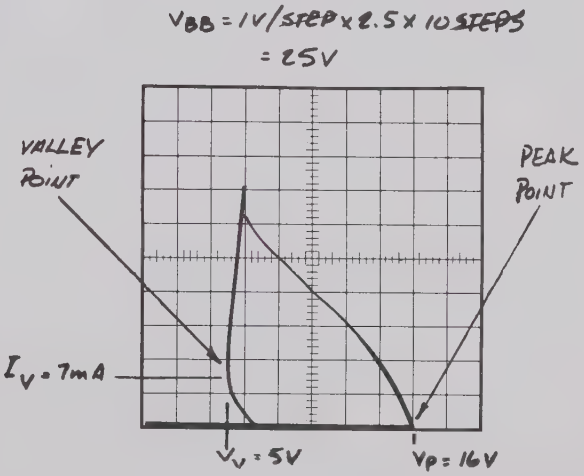


Full Scale Voltage: 20 + NPN

Collector Sweep Voltage: 20

First Step: 10
Last Step: 10
Range: 1 V
Multiplier: 2.50
Mode: Normal

Figure c) Test Setup for Measuring Conduction Characteristics



$\eta = \frac{V_P}{V_{BB}} = \frac{16}{25} = .64$

Vertical: 5 mA/div
Horizontal: 2 V/div

Figure d) Conduction Characteristics

Figure 3-10b. Unijunction Transistor Tests

Section V
Maintenance

5-1. INTRODUCTION

5-2. This section contains information for performance check, calibration and maintenance of the Model 6200B/P. A list of test equipment required for procedures outlined in this section is included.

5-3. TEST EQUIPMENT REQUIRED

5-4. Table 5-1 lists test equipment required for trouble-shooting and adjustment. If the recommended equipment is not available, equipment with equivalent specifications may be substituted. For the performance check, the only equipment required is a 2 kΩ ±1%, ½ W or better resistor.

Table 5-1. Required Test Equipment

EQUIPMENT TYPE	REQUIRED SPECIFICATIONS	RECOMMENDED MODEL
Digital Voltmeter	0.01% accuracy	Systron-Donner 7100A
Voltmeter	4000 V probe 1000 kΩ/V	Simpson Model 269
Oscilloscope	5 mV vertical sensitivity	

5-5. In procedures involving accurate DC voltage or resistance measurements, care must be taken to ensure consistent results. Working standards should be referred to primary standards on a regular basis. Particular care should be taken with resistance standards that are subject to long-term drift due to aging.

5-6. PERFORMANCE CHECK

5-7. The performance check outlined in the following paragraphs is used to verify the specifications of the Model 6200B/P. It can be used upon receipt of a new instrument, for routine preventive maintenance, and following repair. If a failure is indicated at any time during this check, proceed immediately to the calibration procedure.

a. Turn power ON with SCALE LIGHT/POWER switch. Allow one minute warmup.

b. Adjust beam on CRT screen for optimum focus and intensity with FOCUS and INTENSITY controls. If a spot cannot be located on CRT, push and hold HORIZ. SENSITIVITY and VERTICAL SENSITIVITY ZERO switches while rotating vertical and horizontal POSITION potentiometers until beam spot is found. (POSITION controls are concentric knobs on SENSITIVITY switches.) Position spot in approximate center of screen. A slight adjustment of astigmatism may be necessary for minimum distortion. The ASTIG control is located on rear panel of instrument.

c. Make the following control settings:

COLLECTOR SWEEP	fully CCW
FULL RANGE VOLTAGE	+200 NPN
SERIES RESISTOR	1 K
PULSED BASE/NORMAL	NORMAL
POLARITY	+ NPN
LAST SWEEP STEP NO.	10
MULTIPLIER	1
RANGE	.1 V
FIRST SWEEP STEP NO.	0
VERTICAL SENSITIVITY	1 mA
HORIZ. SENSITIVITY	0.1 VOLTS BASE
INVERT/NORMAL	NORMAL
PROGRAMING	LOCAL

d. Press and hold HORIZ. SENSITIVITY ZERO switch and position CRT beam to left side of screen; align on first vertical line of graticule. POSITION control is concentric knob on HORIZ. SENSITIVITY switch.

e. Press and hold VERTICAL SENSITIVITY ZERO switch and position CRT beam to bottom of screen; align on first horizontal line of graticule. POSITION control is concentric knob on VERTICAL SENSITIVITY switch.

f. A series of eleven dots on CRT, each occurring at one large division of the screen, should be observed.

g. Allow a 15 minute warmup before proceeding with next test.

h. Set HORIZ. SENSITIVITY to 0.2 V BASE. Adjust BASE STEP GENERATOR MULTIPLIER dial until all eleven dots again coincide with large graticule divisions. Reading on MULTIPLIER dial should be 2.00 ±3% (2.06 max., 1.94 min.).

i. Set HORIZ. SENSITIVITY to 0.5 V COLLECTOR. Pull out COLLECTOR SWEEP RESET circuit breaker. Jumper BASE terminal to COLLECTOR terminal. Adjust BASE STEP GENERATOR MULTIPLIER dial until all eleven dots again coincide with large graticule divisions. Reading on MULTIPLIER dial should be 5.00 ±3% (5.15 max., 4.85 min.).

j. Set HORIZ. SENSITIVITY to 2 V COLLECTOR. Set BASE STEP GENERATOR RANGE to 1 V. Adjust BASE STEP MULTIPLIER until dots coincide with large graticule divisions. Reading on MULTIPLIER dial should be 2.00 ±3% (2.06 max., 1.94 min.). Remove BASE to COLLECTOR short.

k. Attach a 2 kΩ ±5%, ½ W resistor between COLLECTOR and EMITTER terminals. Push in COLLECTOR SWEEP RESET circuit breaker. Set COLLECTOR SWEEP VOLTAGE to approximately 10%. A 45° trace should be observed on CRT screen, corresponding to 20 V full scale ±1 small division, and 20 mA full scale ±1 small division.

l. Remove 2 kΩ resistor.

5-8. CALIBRATION PROCEDURE

5-9. The paragraphs that follow detail the alignment procedure used to calibrate the Model 6200B/P Curve Tracer. The procedure must be performed in the order given because there is interaction between adjustments. Refer to figure 5-1 for location of test points and adjustment controls.

5-10. Initial Control Settings and Warmup

CAUTION

WHILE THE INSTRUMENT IS REACHING OPERATING TEMPERATURE, TURN INTENSITY CONTROL FULLY COUNTER CLOCKWISE AND PULL OUT COLLECTOR SWEEP RESET SWITCH.

5-11. To adjust instrument for calibration check, proceed as follows:

a. Set front and rear panel controls as detailed below:

COLLECTOR SWEEP VOLTAGE	0
FULL RANGE VOLTAGE	+20 NPN
SERIES RESISTOR RL1	1 MΩ
Horizontal POSITION	½ turn C.W.
Vertical POSITION	½ turn C.W.
VERTICAL SENSITIVITY	50 mA/div
HORIZ. SENSITIVITY	.1 V/div COLLECTOR
FIRST SWEEP STEP NO.	0
LAST SWEEP STEP NO.	0
PROGRAMING	LOCAL
BASE RANGE	.1 V
MULTIPLIER	1
POLARITY	+ NPN
PULSED BASE/NORMAL	NORMAL
Vertical INVERT/NORMAL	NORMAL
Horiz. INVERT/NORMAL	NORMAL

b. Turn SCALE LIGHT/POWER switch ¼ turn C.W. to ON power position.

c. Allow at least a thirty minute warmup period for instrument to stabilize before attempting calibration.

5-12. ±45 Volt and +225 Volt Power Supply Adjustments

5-13. To check and calibrate ±45 V and +225 V power supplies, perform following steps:

a. Remove top cover from instrument.

b. Connect digital voltmeter between test points listed in table 5-2 and check that all outputs are within tolerance. Make adjustments where necessary.

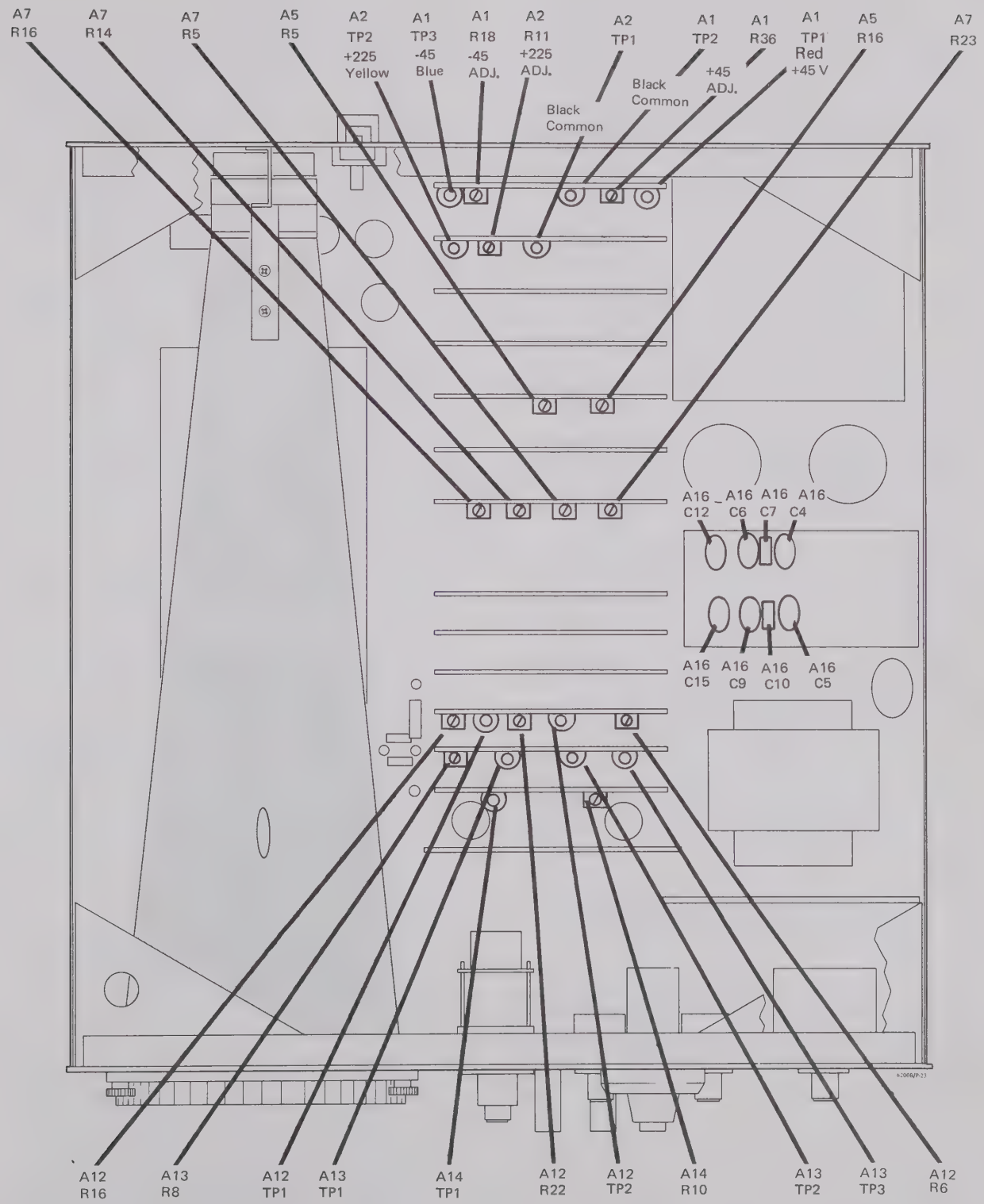


Figure 5-1. Adjustment Controls

Table 5-2. ±45 Volt and +225 Volt Supply Specifications

POWER SUPPLY	TEST POINTS	OUTPUT	ADJUSTMENT	TOLERANCE	MAXIMUM 120 Hz RIPPLE	MAXIMUM HF NOISE
+45 V	A1TP1 (+)	+45 V	A1R36	+50 mV	10 mV	5 mV
	A1TP2 (GND)			- 0 mV	p.p.	
-45 V	A1TP2 (GND)	-45 V	A1R18	+50 mV	10 mV	5 mV
	A1TP3 (-)			- 0 mV	p.p.	
+225 V	A2TP2 (+)	+225 V	A2R11	+ 1 V	50 mV	25 mV
	A2TP1 (GND)			- 0 V	p.p.	

c. Check 120 Hz ripple and HF noise with oscilloscope. Results should be below maximum readings given in table 5-2.

5-14. **-2500 Volt Supply Check**

WARNING

LETHAL VOLTAGES ARE PRESENT IN THE 2500 VOLT SUPPLY. OBSERVE PROPER PRECAUTIONS WHEN MAKING MEASUREMENTS.

5-15. The HV supply is referenced to the +225 V supply and the HV output is not adjustable. To measure the HV output level proceed as follows:

a. Connect positive terminal of voltmeter (100 kΩ/V input impedance) to front panel EMITTER terminal.

b. Using 4000 V probe, connect negative terminal of voltmeter to terminal 3 of front panel INTENSITY control R241. The voltmeter should read -2500 V ±125 V.

c. Remove voltmeter.

5-16. **Base Step Generator Alignment**

5-17. The base step generator is aligned as follows:

a. Connect jumper between EMITTER and BASE terminals.

b. Connect DVM to A13TP1. Use front panel EMITTER terminal for GND.

c. Adjust A13R8 until DVM reads less than 100 μV.

d. Remove EMITTER to BASE jumper and replace with a voltmeter.

e. Set FIRST SWEEP STEP NO. to 1 and LAST SWEEP STEP NO. to 1.

f. Switch BASE POLARITY from + NPN to -PNP and adjust A14R10 until voltmeter reads same voltage ±1 mV in both polarities.

g. Set FIRST and LAST SWEEP STEP NO. to 10 and MULTIPLIER dial to 10.

NOTE

If 10th step cannot be obtained, carry out procedure detailing in paragraph 5-29 before proceeding.

h. Adjust A12R22 until the voltmeter reads 10.000 V ±10 mV.

i. Set FIRST and LAST STEP switches to 1 and adjust MULTIPLIER potentiometer to 1.

j. Adjust ZERO STEP ADJUST (located on front panel) until DVM reads +0.1000 V ±1.5 mV.

k. It is recommended that all ranges be spot checked for accuracy.

l. Remove DVM from BASE terminal.

5-18. **Pulsed Base Adjustment**

5-19. The pulsed base circuitry is adjusted as follows:

a. Set controls as follows:

BASE STEP RANGE	0.1 V
POLARITY	+ NPN
MULTIPLIER	1.0
FIRST SWEEP STEP NO.	0
LAST SWEEP STEP NO.	1
PULSED/NORMAL	PULSED
FULL RANGE VOLTAGE	+20 NPN
SERIES RESISTOR	1 KΩ
COLLECTOR SWEEP VOLTAGE	20

COLLECTOR SWEEP RESET IN

b. Connect channel A of a dual trace oscilloscope to COLLECTOR terminal. Observe output of BASE terminal on channel B. Check that signal on channel B consists of pulses of 100 mV amplitude alternately occurring with a 120 Hz, 20 V collector pulse observed on channel A.

TRIGGER OSCILLOSCOPE EXT. WITH COLLECTOR SWEEP.

c. Adjust A12R6 until base step pulse occurs at peak of collector waveform. Width of pulse should be 750 μsec ±100 μsec.

PULSED/NORMAL NORMAL

5-20. **Horizontal Amplifier DC Balance Adjustment**

5-21. To adjust horizontal amplifier DC balance, proceed as follows:

a. Connect a jumper between front panel COLLECTOR and EMITTER terminals. Increase INTENSITY control setting until a dot appears on CRT screen.

b. Depress COLLECTOR SWEEP RESET pushbutton.

c. Position dot in center of screen with horizontal POSITION control.

d. Switch HORIZ. SENSITIVITY from 0.1 V/div to 0.01 V/div and note direction of travel of trace.

e. Move trace back to center of CRT with DC Balance Adjustment A7R5.

f. Set HORIZ. SENSITIVITY to .1 V/div.

g. Repeat steps c, d, e and f until there is no movement between range changes.

h. Remove jumper from COLLECTOR and EMITTER terminals.

5-22. **Horizontal Amplifier Gain Adjustment**

5-23. To adjust gain of horizontal amplifier, carry out following steps:

a. Connect a jumper between front panel COLLECTOR and BASE terminals.

b. Connect DVM across COLLECTOR and EMITTER terminals.

c. Set POLARITY to + NPN.

d. Set FIRST and LAST SWEEP STEP NO. switches to 10.

e. Set HORIZ. SENSITIVITY to .1 V/div. Adjust multiplier dial until voltmeter reads 1.000 V ±1 mV.

f. Depress HORIZ. ZERO pushbutton and position beam spot precisely on first left vertical graticule with horizontal POSITION control. Release ZERO button.

g. Adjust A7R23 until spot coincides with first right vertical graticule.

h. Repeat steps f and g until dot falls on both the left and right graticule lines.

i. Set RANGE switch to .01 V and the HORIZ. SENSITIVITY to .02 V/div.

j. Adjust MULTIPLIER dial until the voltmeter reads 0.2000 V ±100 μV.

k. Repeat step f.

l. Adjust A7R14 until dot again coincides with first right vertical graticule.

m. Repeat steps k and l until dot falls on both left and right graticule lines.

n. Set HORIZ. SENSITIVITY to 0.01 V/div and adjust MULTIPLIER dial until the voltmeter reads 0.1000 V ±100 μV.

o. Repeat step f.

p. Adjust A7R16 until dot coincides with first graticule.

q. Press HORIZ. ZERO pushbutton and check that dot still aligns with first left graticule. Repeat steps p and q if necessary.

r. Set RANGE to 1 V and HORIZ. SENSITIVITY to 1 V/div.

s. Adjust MULTIPLIER dial until the voltmeter reads 10.000 V ±10 mV.

t. Repeat step f.

u. Check that the dot falls directly on the first right graticule line ±1½ small divisions.

v. Remove DVM and the COLLECTOR to BASE short.

5-24. **Vertical Amplifier DC Balance Adjustment**

5-25. To adjust vertical amplifier DC balance adjustment proceed as follows:

a. Depress vertical ZERO pushbutton and position beam spot behind center line on extreme left vertical graticule line with vertical POSITION control.

b. Switch VERTICAL SENSITIVITY from 50 mA/div to 20 mA/div and note direction of vertical spot movement.

c. Move spot back to center of CRT with DC balance adjustment A5R5.

d. Repeat step b. Continue to adjust A5R5 until there is no vertical spot movement between range changes.

5-26. **Vertical Amplifier Gain Adjustment**

5-27. To adjust gain of vertical amplifier proceed as follows:

a. Set front panel controls as detailed below:

HORIZ. SENSITIVITY	0.1 V/div
VERTICAL SENSITIVITY	1 mA/div
SERIES RESISTOR	3 Ω
FULL RANGE VOLTAGE	+20 NPN

b. Connect a 100 Ω ±1%, ½ W resistor across COLLECTOR and EMITTER terminals.

c. Position beam spot precisely behind lower left corner of graticule.

d. Rotate COLLECTOR SWEEP VOLTAGE control until trace crosses extreme right vertical graticule line.

e. Adjust A5R16 (vertical amplifier gain) until trace crosses from the center of lower left corner to the center of upper right corner of graticule, i.e., a 45° slope. (Reposition trace if necessary as adjustment is being made.) Decrease COLLECTOR SWEEP VOLTAGE.

f. Remove the 100 Ω resistor and connect a 10 Ω ±1%, ½ W resistor.

g. Change HORIZ. SENSITIVITY to 0.2 V/div and VERTICAL SENSITIVITY to 20 mA/div.

h. Rotate COLLECTOR SWEEP VOLTAGE control until trace just crosses extreme right vertical graticule line. Check that trace again crosses from lower left to upper right corners ±1.5 minor division. Decrease COLLECTOR SWEEP VOLTAGE.

i. Remove the 10 Ω resistor and connect a 10 kΩ ±1% resistor across COLLECTOR and EMITTER terminals.

j. Change HORIZ. SENSITIVITY to .05 V/div and VERTICAL SENSITIVITY to 5 μA/div.

k. Rotate COLLECTOR SWEEP VOLTAGE control clockwise and check again that trace is from lower left corner to upper right corner ±1.5 minor division.

l. Remove 10 kΩ resistor between COLLECTOR and EMITTER terminals.

5-28. **BASE RESET PULSE CALIBRATION**

5-29. To adjust the reset level of the base staircase generator, proceed as follows:

a. Return FRONT PANEL CONTROLS to initial control settings listed in paragraph 5-~~2~~.11a
CONNECT JUMPER ACROSS COLLECTOR & BASE TERMINALS.

b. Set HORIZONTAL SENSITIVITY switch to .1 V/div. BASE and LAST STEP switch to 10. Check that there are eleven dots on the CRT, each occurring at one large division on the screen. If necessary, adjust HORIZ. POSITION control.

c. If there are more or less than eleven dots, adjust A12R16 for eleven dots. (Note: Adjust for a tail of one-half of a large division.)

d. REMOVE JUMPER FROM ACROSS COLLECTOR & BASE TERMINALS.

5-30. **Hysteresis Adjustment**

NOTE

This adjustment was made at the factory with a Model 3509B Curve Tracer Programer cabled to the Model 6200B/P and compensates for stray capacitances introduced through the front panel B, C, and E terminals. If the curve tracer is used with another type of programer or test fixture, the stray capacitances will be altered. Whenever stray capacitances are changed, this adjustment procedure must be followed.

5-31. Hysteresis can be reduced to a minimum by the following procedure:

a. Set front panel controls as follows:

VERTICAL SENSITIVITY	1 μA
SERIES RESISTOR	3 Ω
HORIZ. SENSITIVITY	2 V/div
FULL RANGE VOLTAGE	+20 NPN
COLLECTOR SWEEP VOLTAGE	fully clockwise

b. Adjust A16C15 and/or A16C12 to merge the four lines as nearly as possible to two lines on CRT screen. See figure 5-1 for location of adjustment screws.

c. Change control settings as follows:

HORIZ. SENSITIVITY	100 V/div
FULL RANGE VOLTAGE	+1000 NPN

d. Adjust A16C4 and A16C5 for minimum distance between lines.

e. Adjust A16C9 and A16C6 for minimum distance between the two lines on CRT screen.

NOTE

If this adjustment will not decrease the distance to less than 3 divisions, add more capacitance in parallel with A16C9 and A16C6. Capacitors A16C7 and A16C10 may be removed and replaced with larger capacitors if necessary (use capacitors with 1 kV rating).

f. Readjust A16C15 and A16C5 for minimum distance between lines as in steps b and c if necessary.

g. Check following ranges to verify that line spacing is not appreciably different than that noted in step f.

HORIZ. SENSITIVITY	20 V
FULL RANGE VOLTAGE	-200 V PNP
HORIZ. SENSITIVITY	100 V
FULL RANGE VOLTAGE	-1000 PNP
HORIZ. SENSITIVITY	2 V
FULL RANGE VOLTAGE	-20 PNP
HORIZ. SENSITIVITY	20 V
FULL RANGE VOLTAGE	+200 NPN

5-32. **PERIODIC MAINTENANCE**

5-33. The Model 6200B/P requires little periodic maintenance. The procedure in the following paragraphs may be used when maintenance is performed on a regular basis.

5-34. **Inspection**

5-35. Remove top and bottom covers from instrument. Inspect the chassis and mounted components for damage, signs of overheating, etc. Remove circuit boards and inspect for damage or signs of failure. Using low pressure, dry, compressed air, blow out any dust accumulation.

5-36. Rotate front panel controls through full range, noting any binding or rough action.

5-37. Following inspection, replace all circuit boards and covers. Make performance check detailed in paragraph 5-7.

5-38. **COMPONENT LOCATION AND SCHEMATIC DIAGRAMS**

5-39. Figures 5-2 through 5-40 show: a) overall wiring diagram, b) schematics for plug-in assemblies, and c) location of components on main frame of instrument and plug-in assemblies.

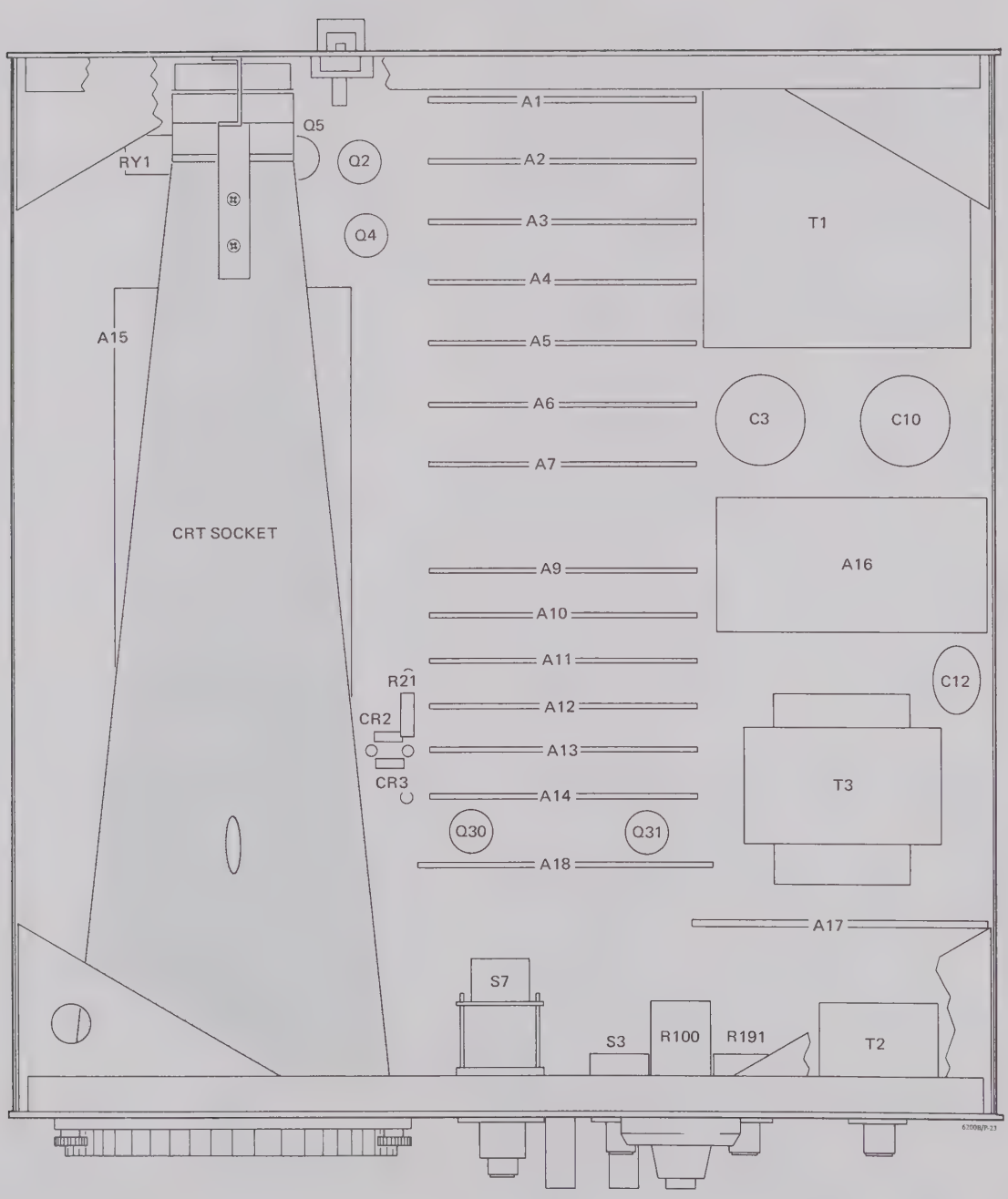


Figure 5-2. Main Frame Component Location, Top View

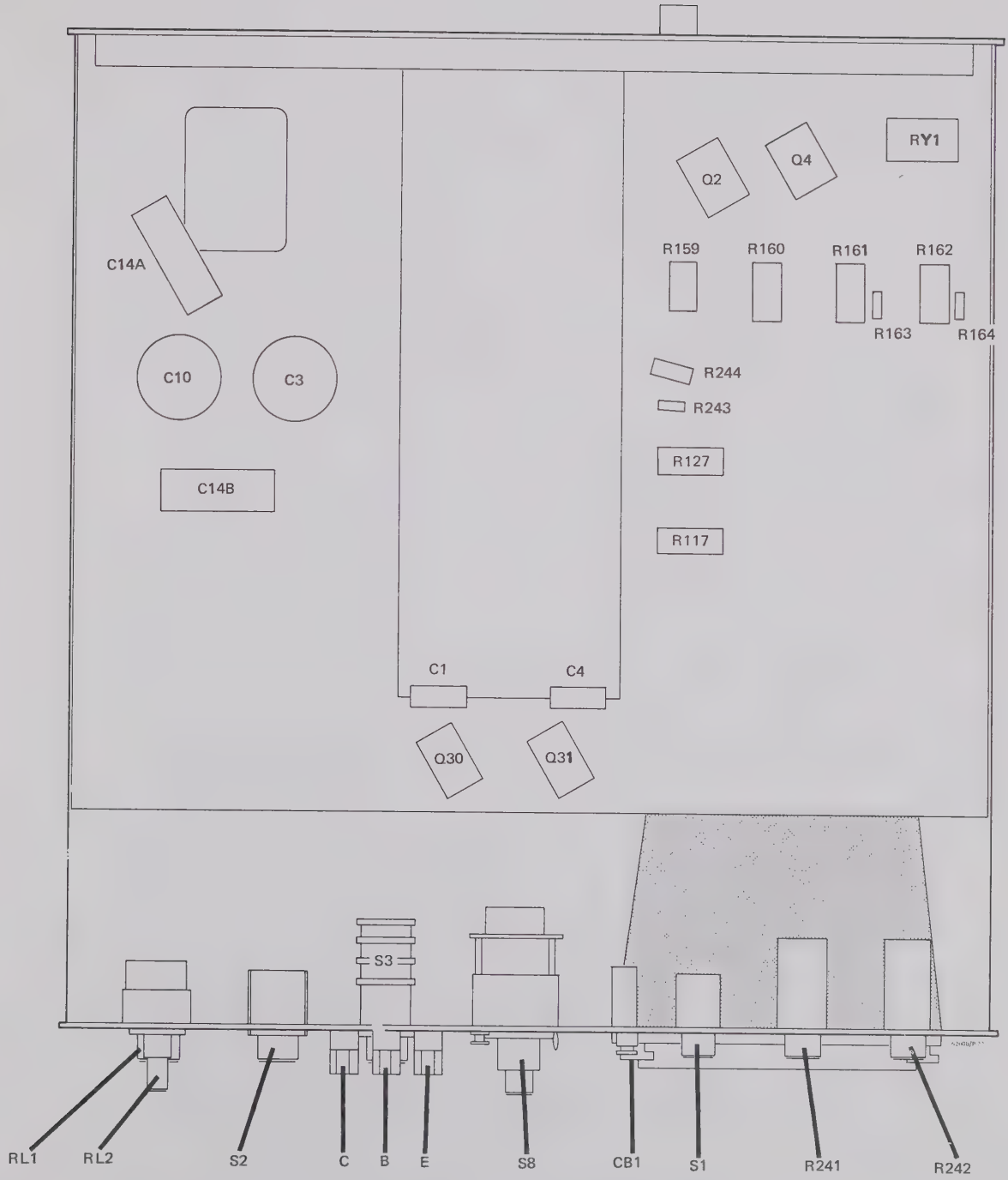


Figure 5-3. Main Frame Component Location, Bottom View

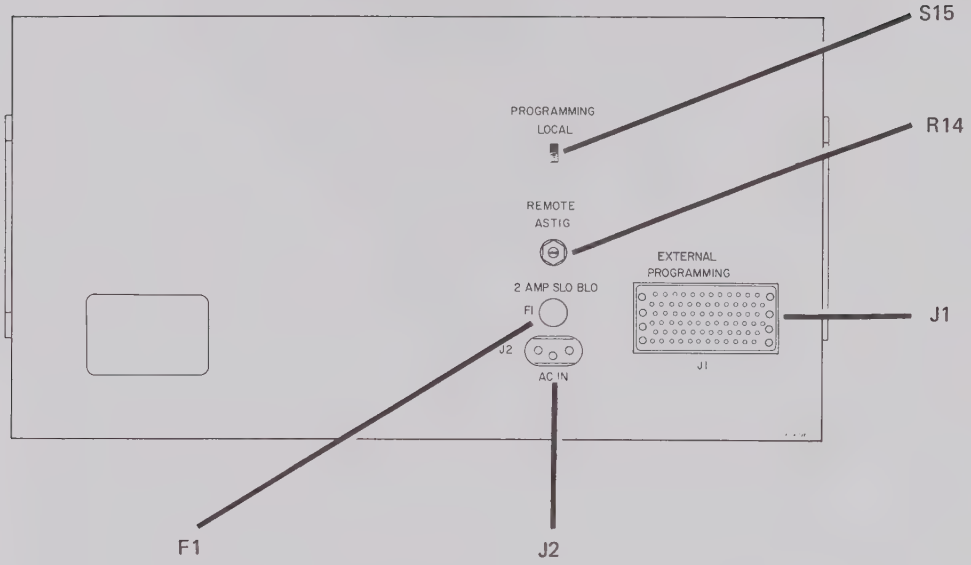


Figure 5-4. Component Location, Rear Panel

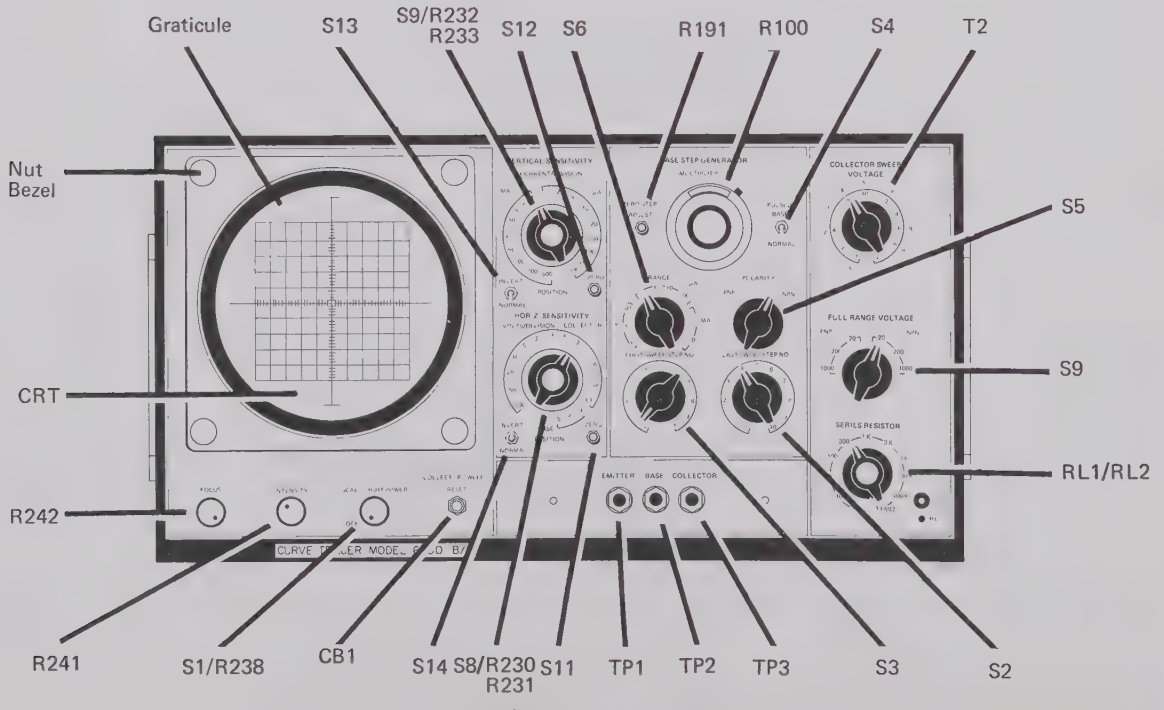


Figure 5-5. Component Location, Front Panel

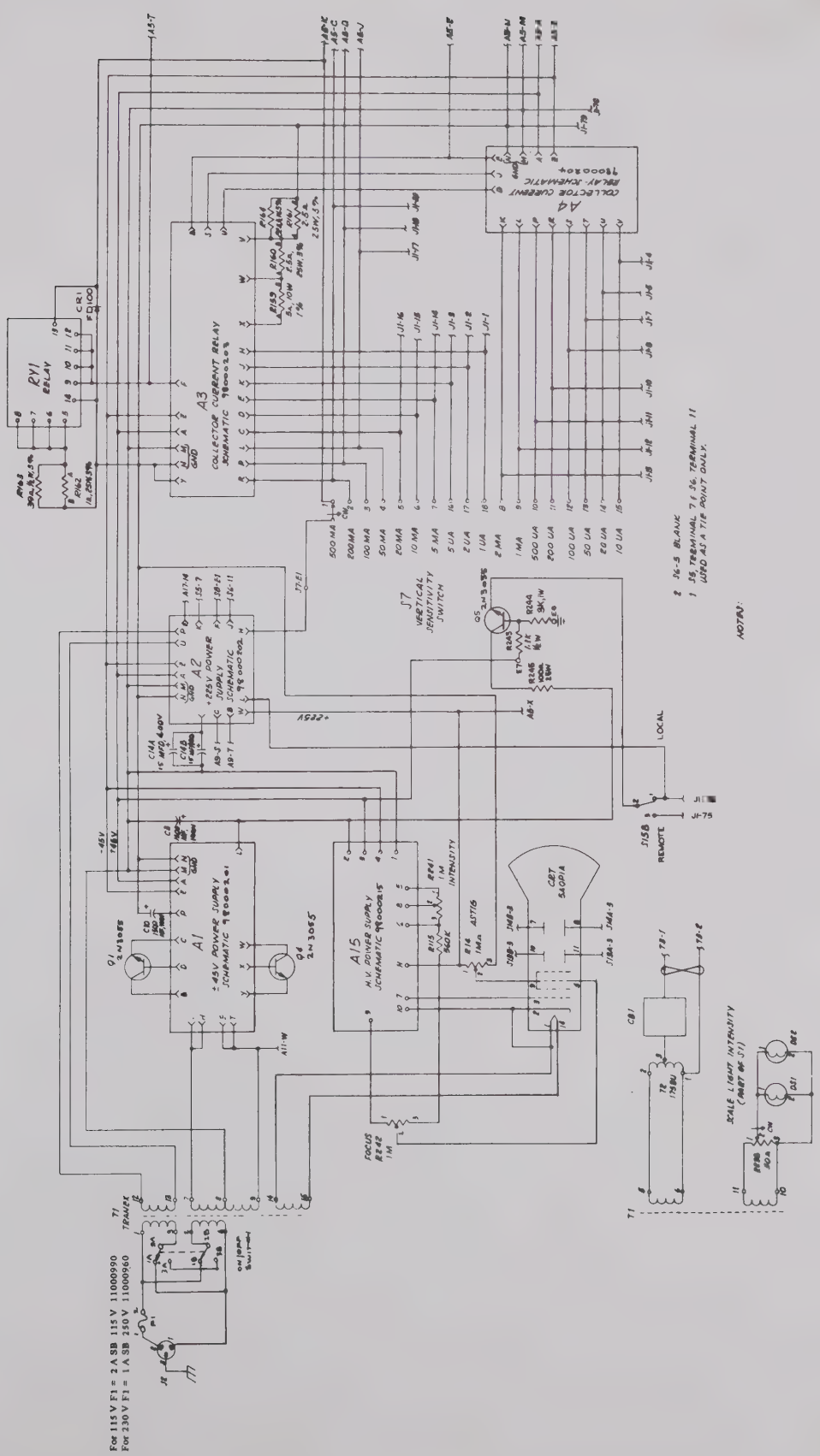


Figure 5-6. Interconnect Diagram, Model 6200B/P (Sheet 1 of 4)

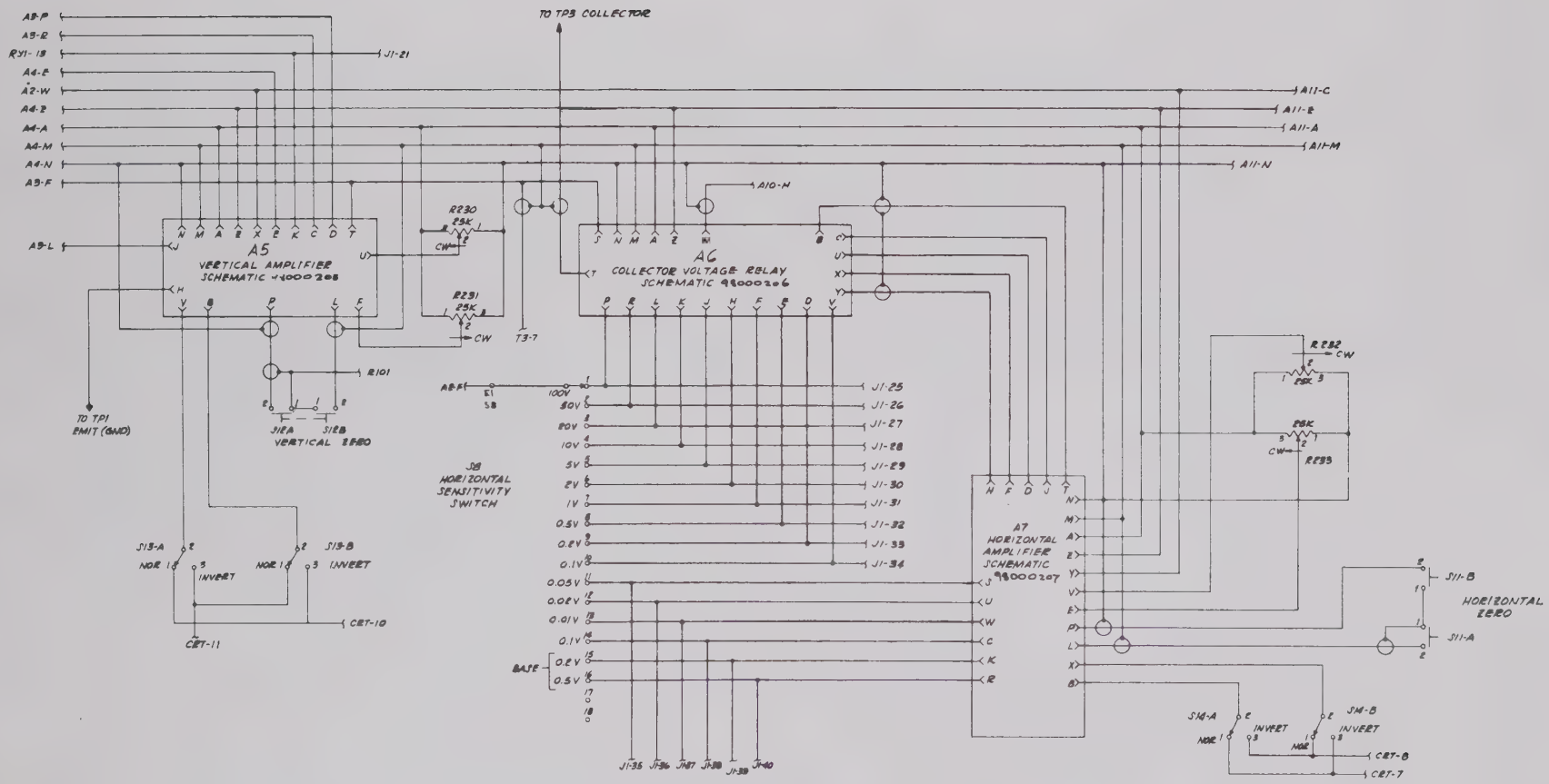


Figure 5-6. Interconnect Diagram, Model 6200B/P (Sheet 2 of 4)

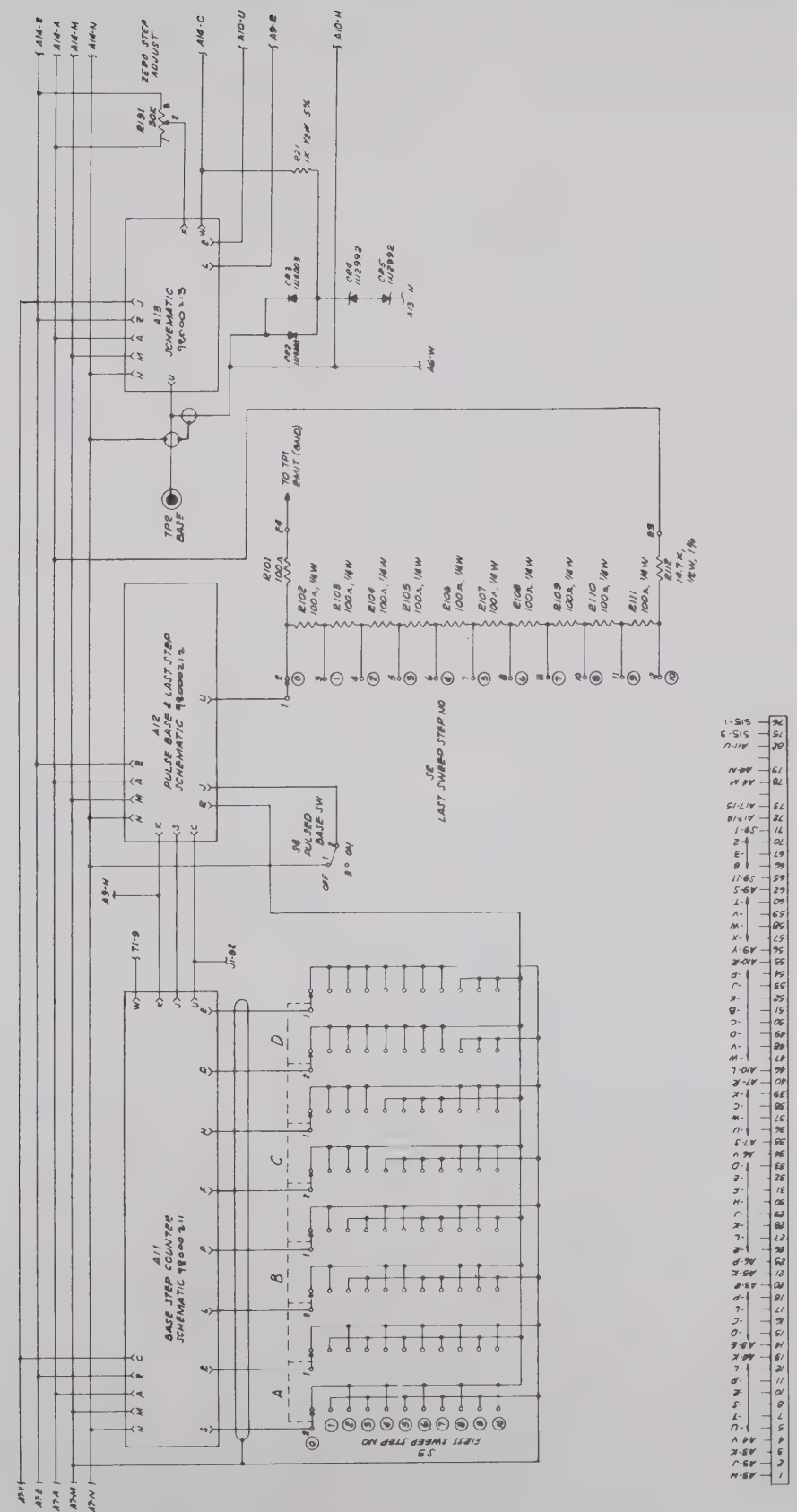


Figure 5-6. Intercomnect Diagram, Model 6200B/P (Sheet 3 of 4)

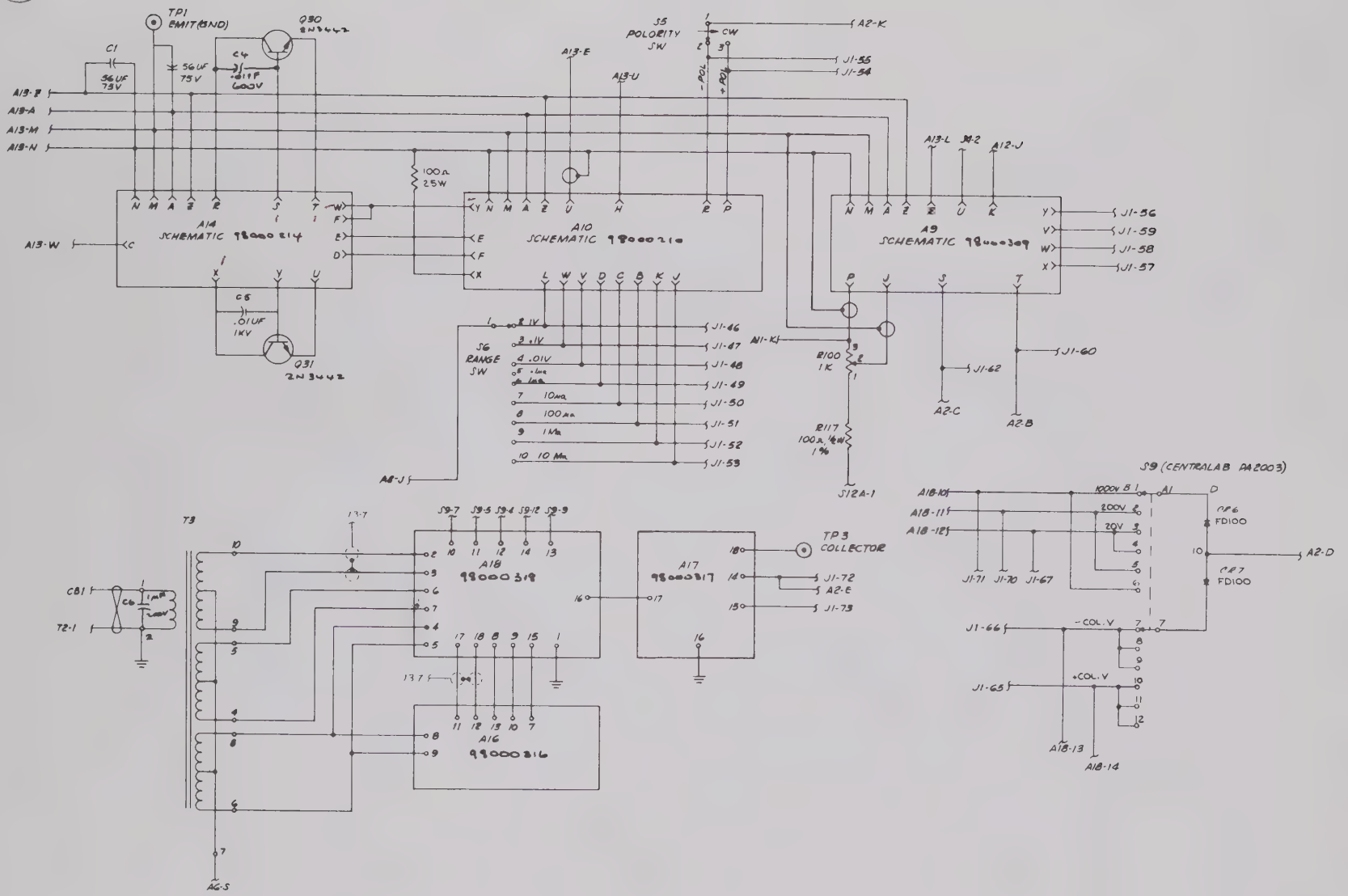


Figure 5-6. Interconnect Diagram, Model 6200B/P (Sheet 4 of 4)

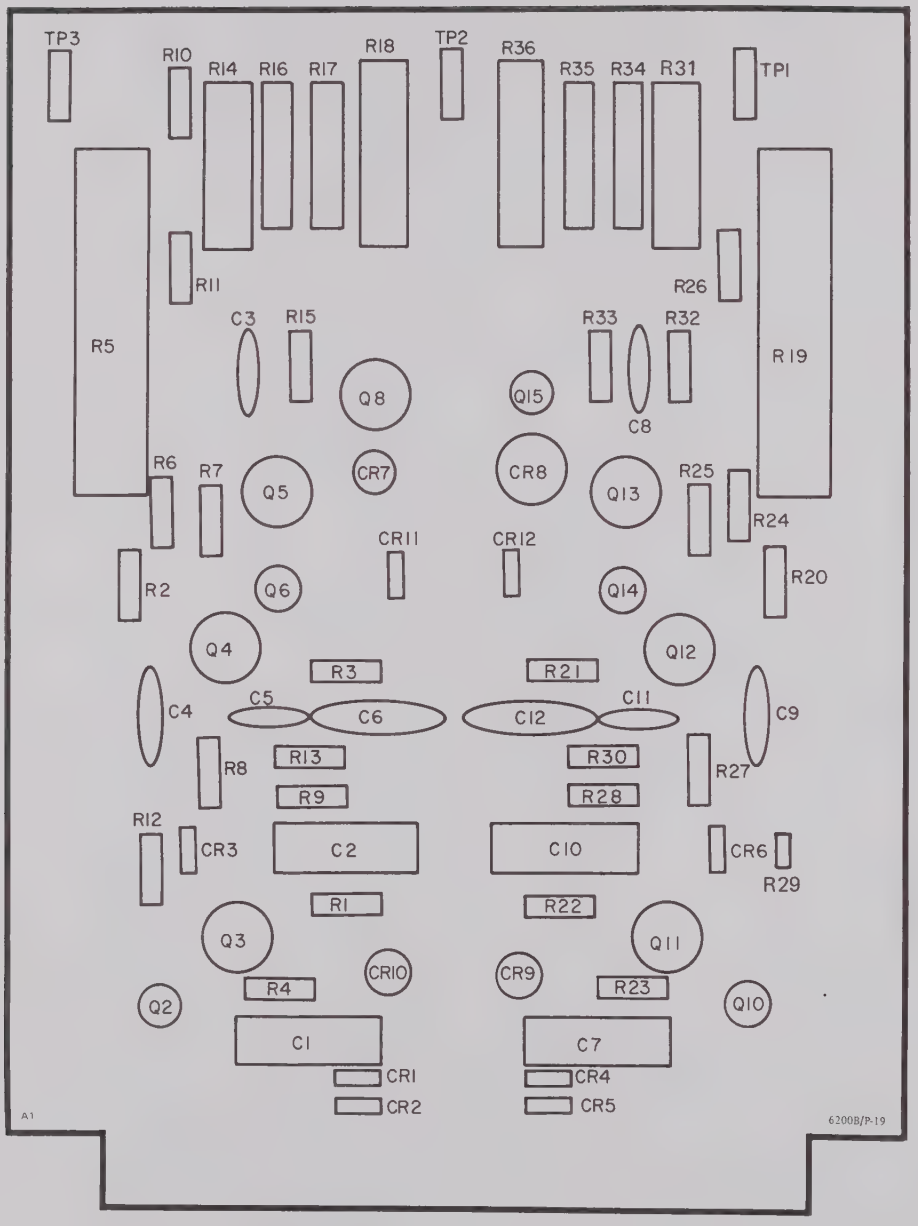


Figure 5-7. Component Location, ±45V Power Supply Assembly A1

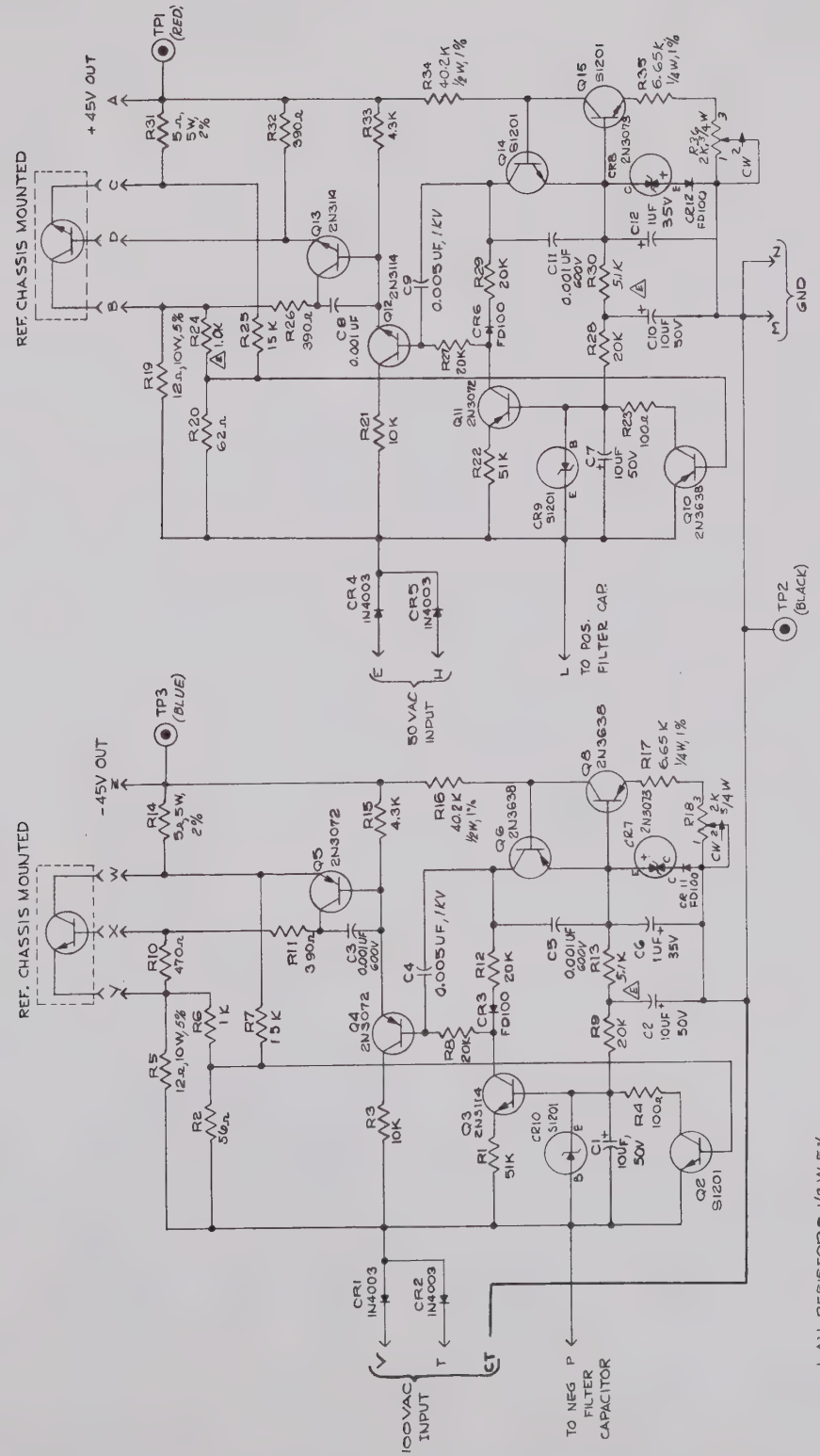


Figure 5-8. Schematic, ±45 V Power Supply Assembly A1

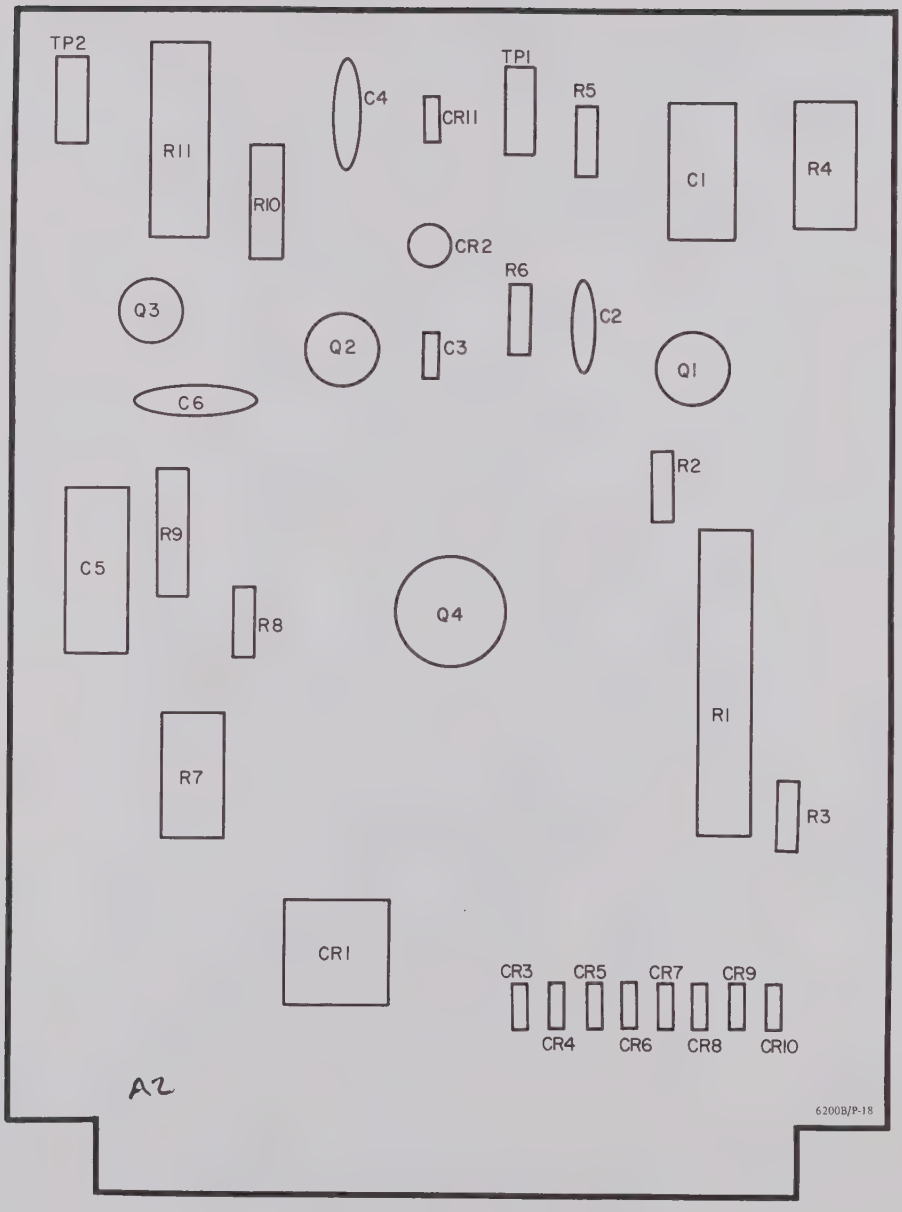


Figure 5-9. Component Location, +225 Volt Power Supply Assembly A2

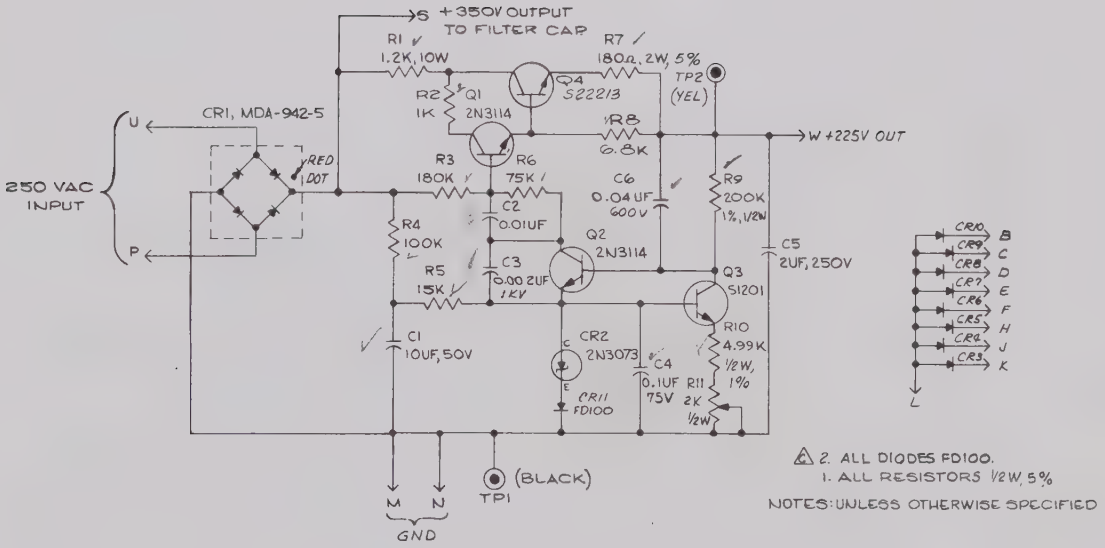


Figure 5-10. Schematic, +225 V Power Supply Assembly A2

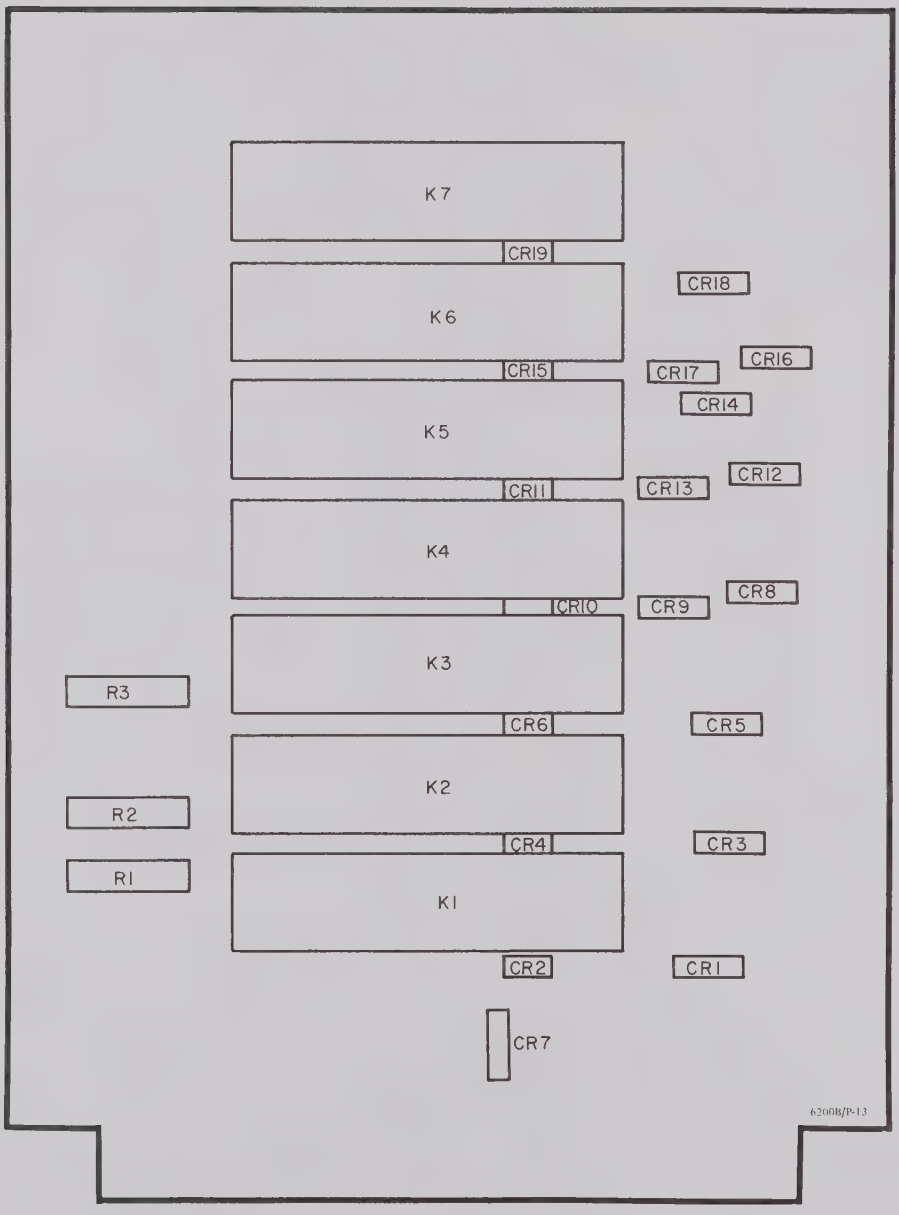
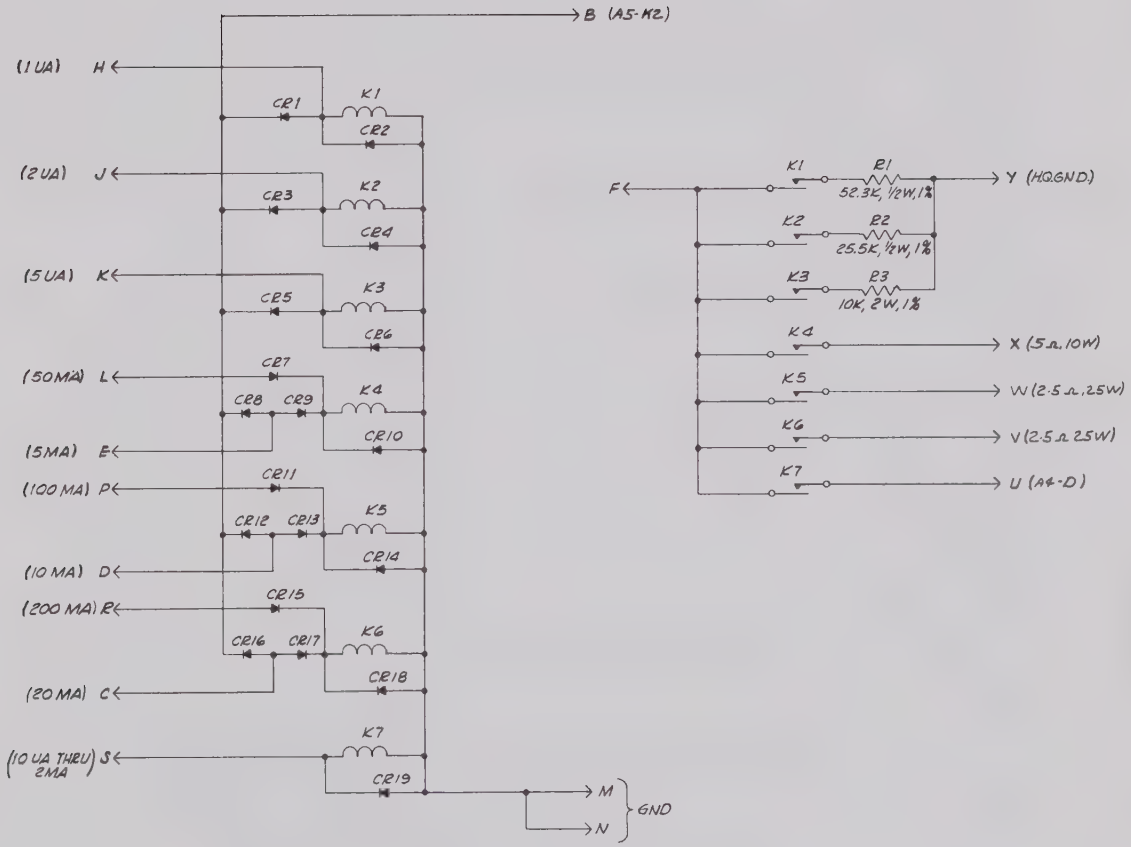


Figure 5-11. Component Location, Collector Current Relay Assembly A3



1. ALL DIODES ARE FD100

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 5-12. Schematic, Collector Current Relay Assembly A3

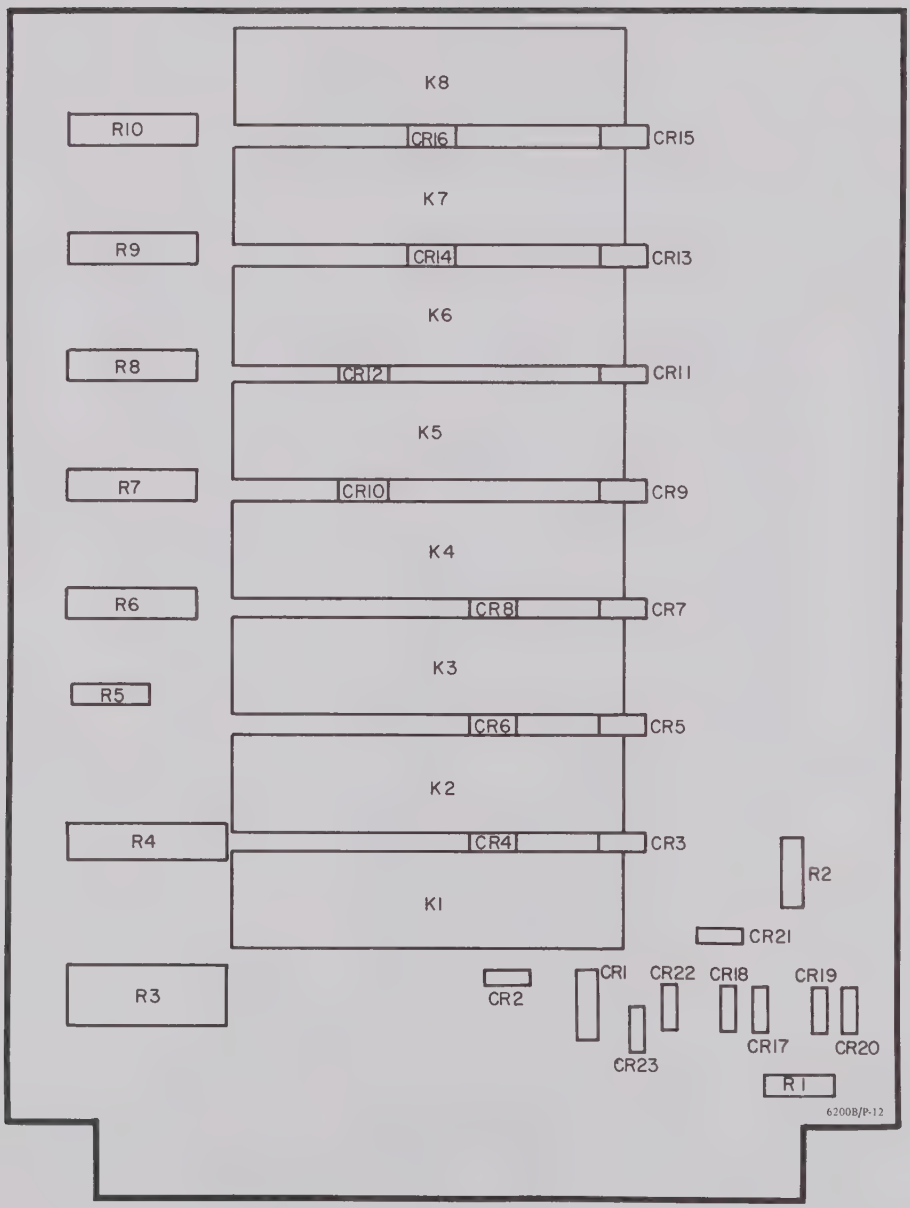
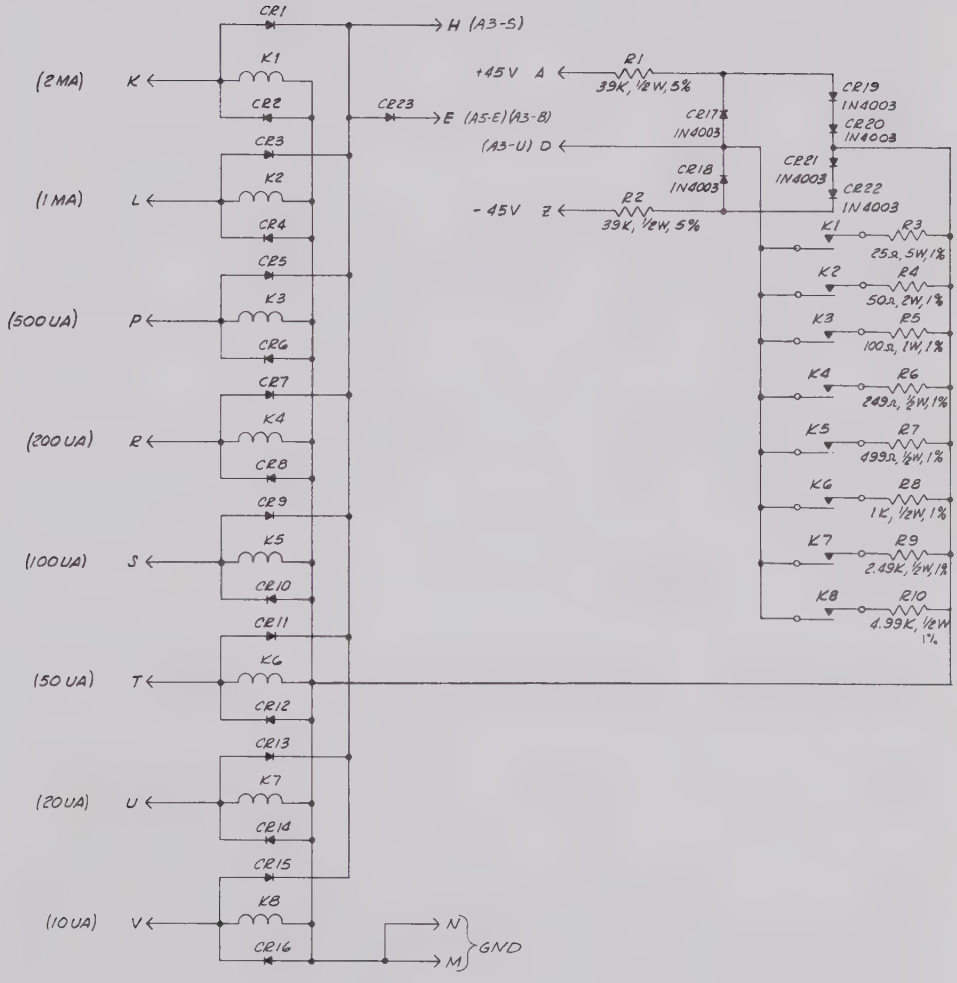


Figure 5-13. Component Location, Collector Current Relay Assembly A4



1. ALL DIODES ARE FD-100

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 5-14. Schematic, Collector Current Relay Assembly A4

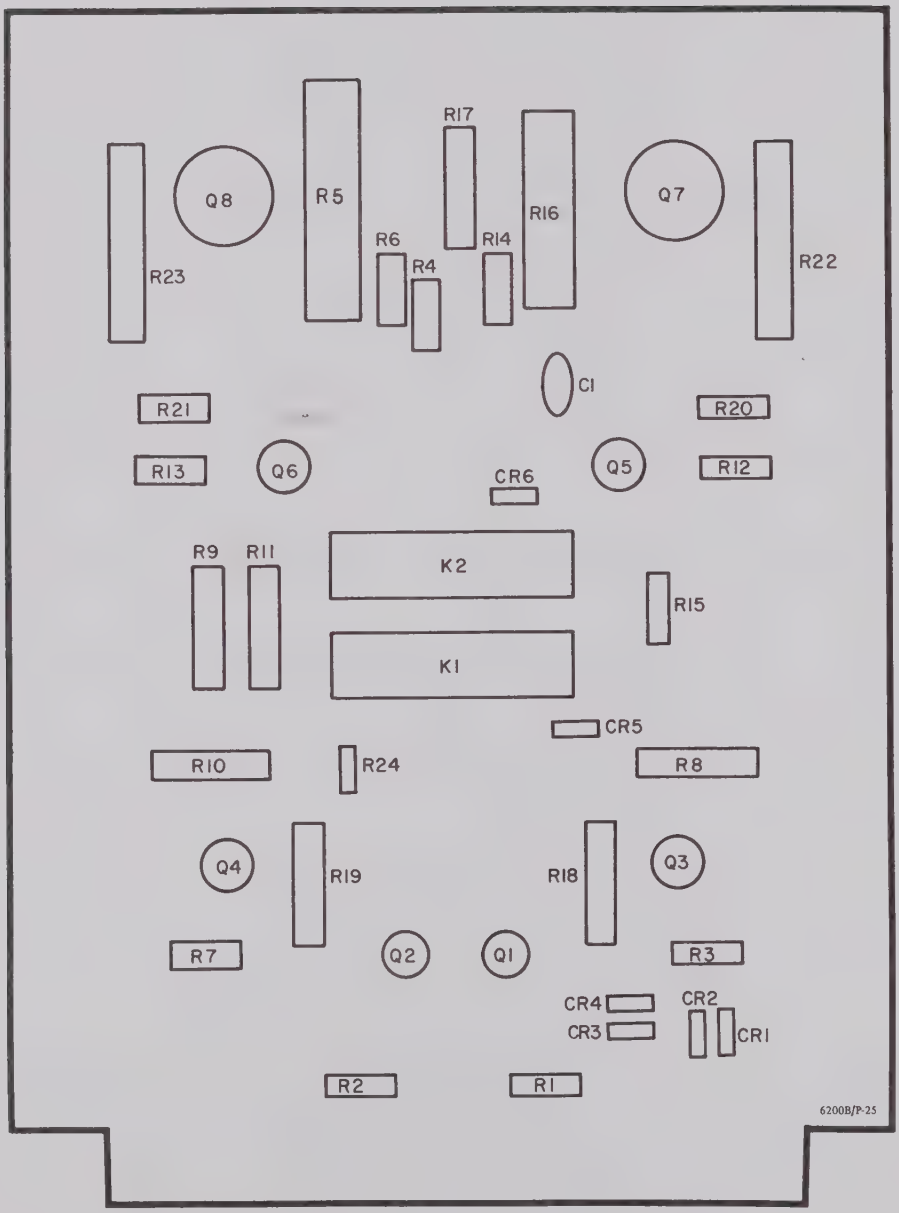


Figure 5-15. Component Location, Vertical Amplifier Assembly A5

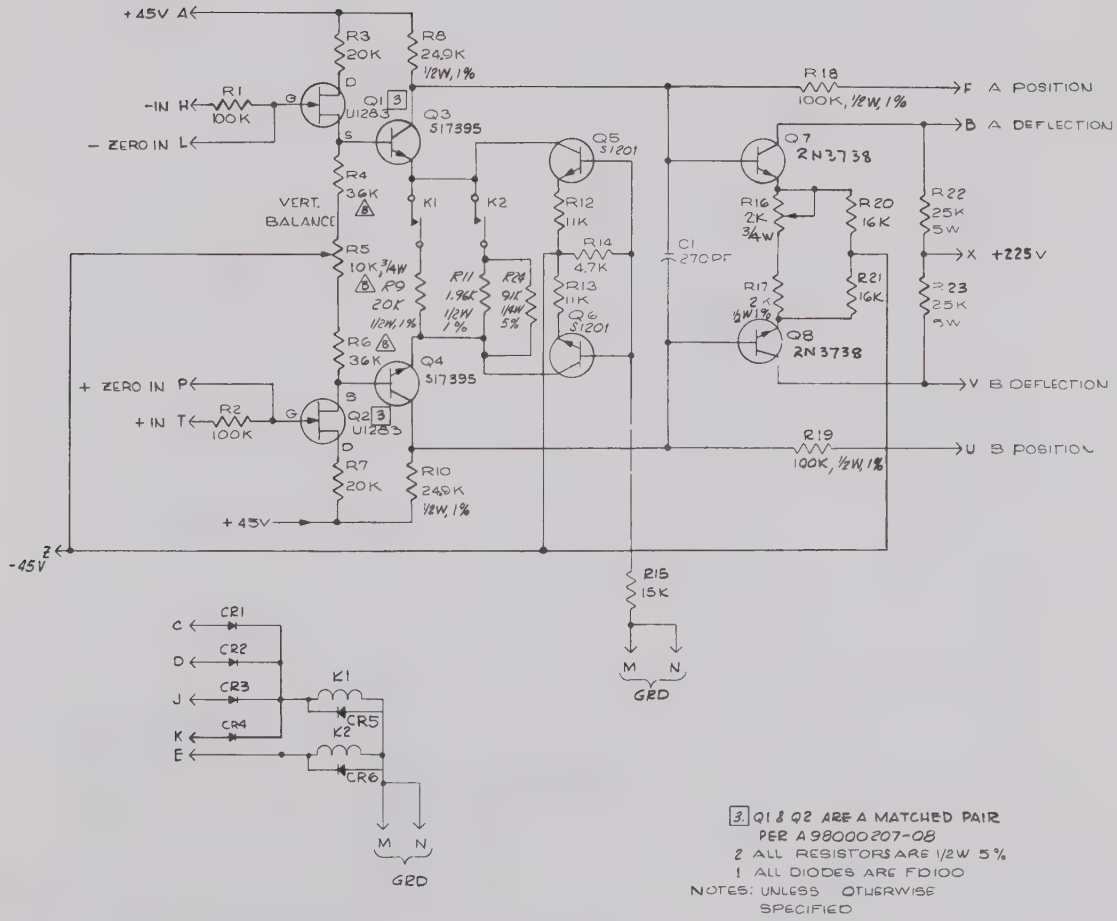


Figure 5-16. Vertical Amplifier Assembly A5

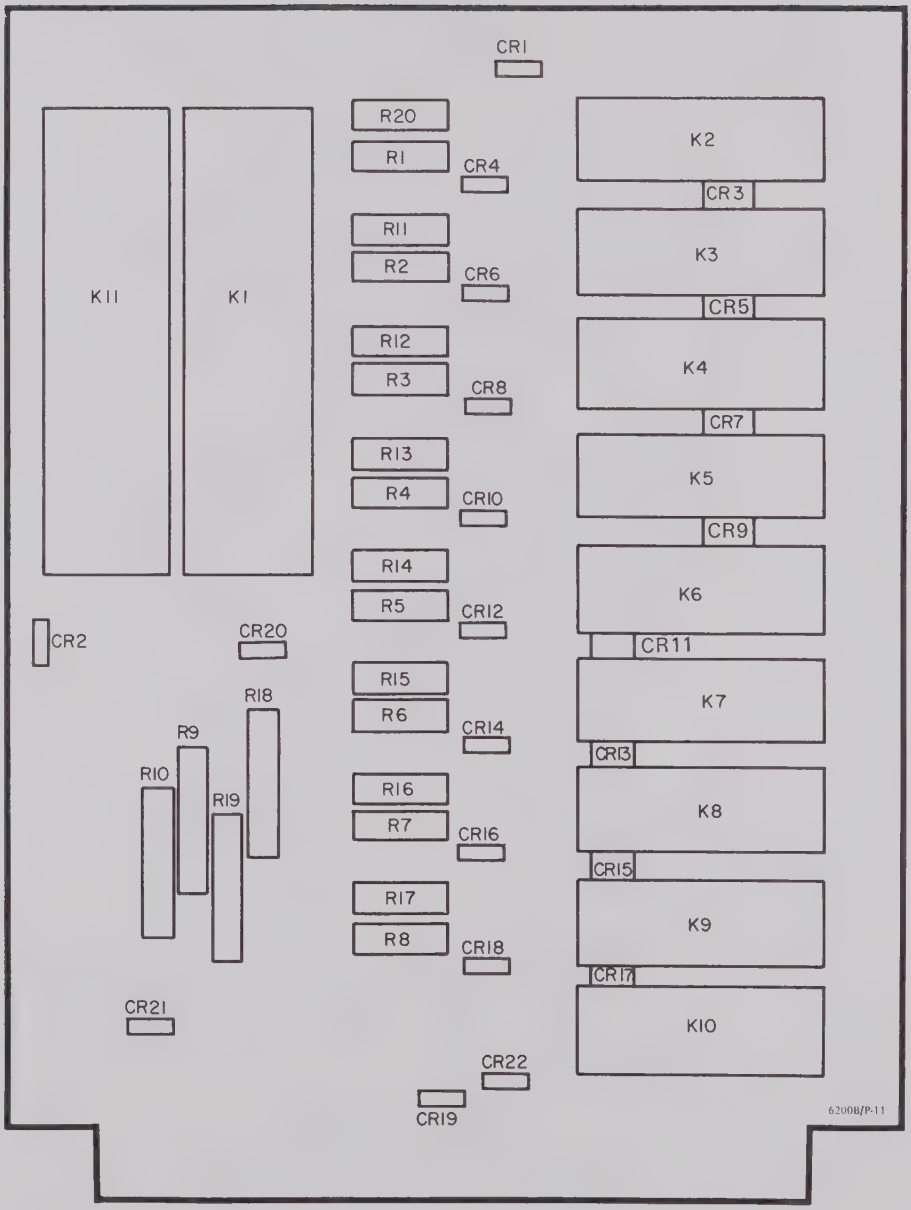


Figure 5-17. Component Location, Collector Voltage Relay Assembly A6

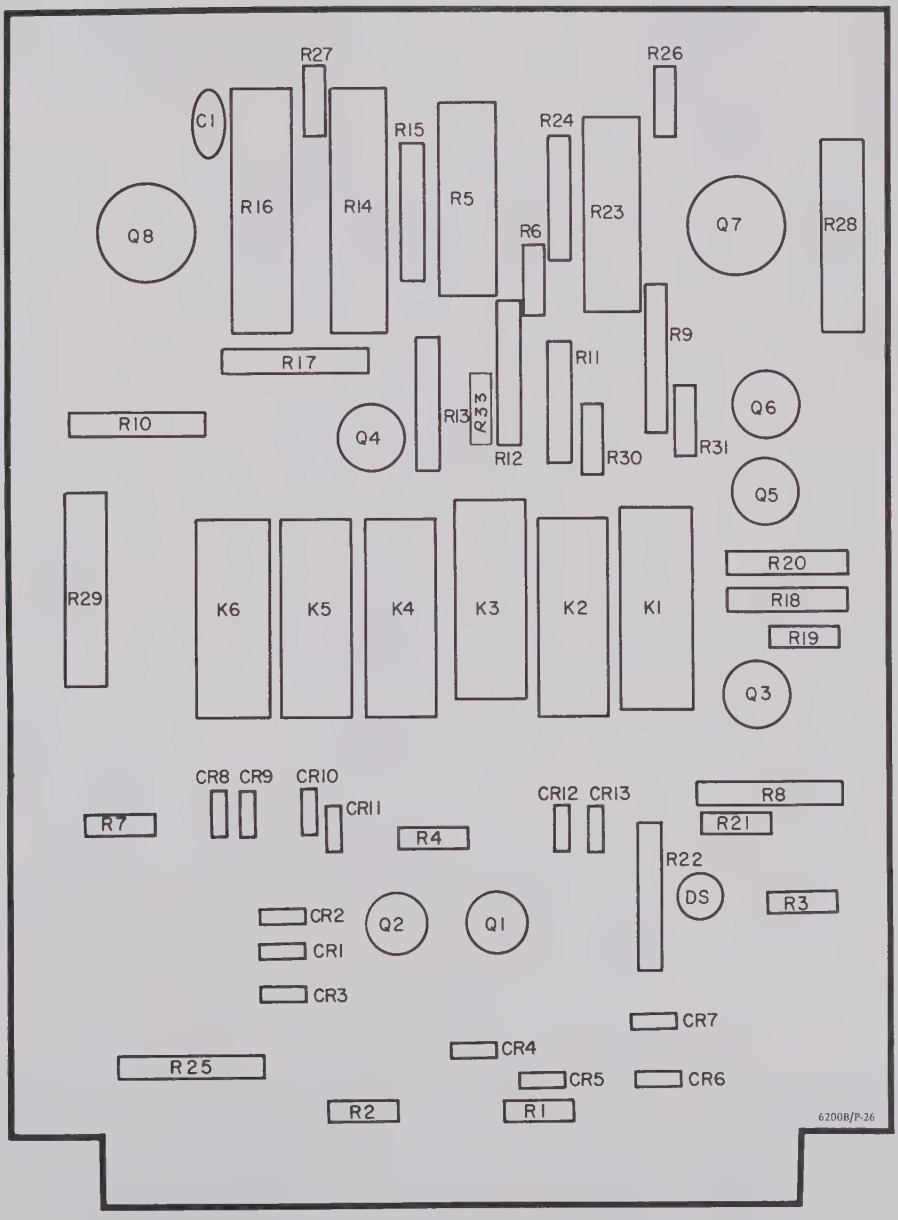


Figure 5-19. Component Location, Horizontal Amplifier Assembly A7

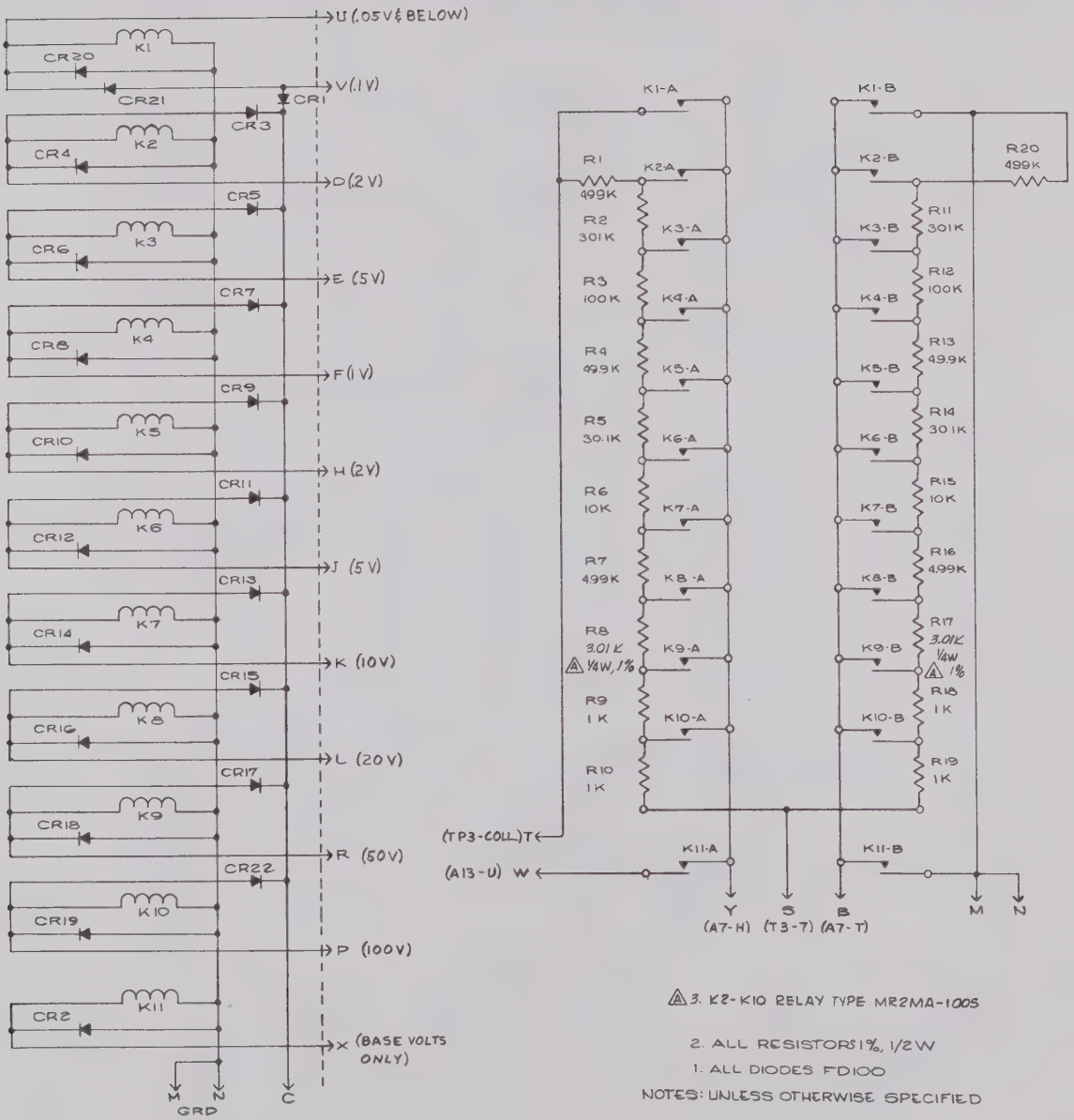


Figure 5-18. Schematic, Collector Voltage Relay Assembly A6

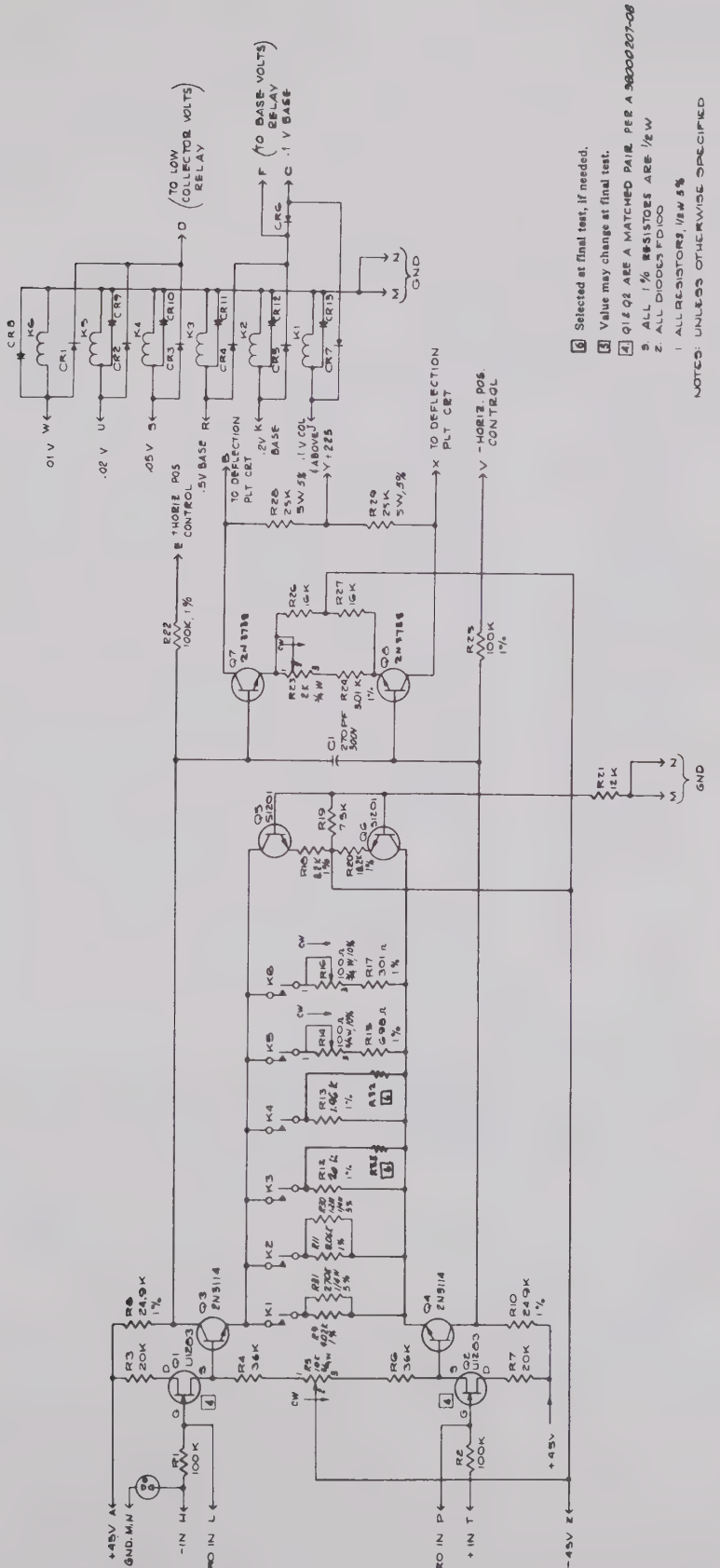


Figure 5-20. Horizontal Amplifier Assembly A7

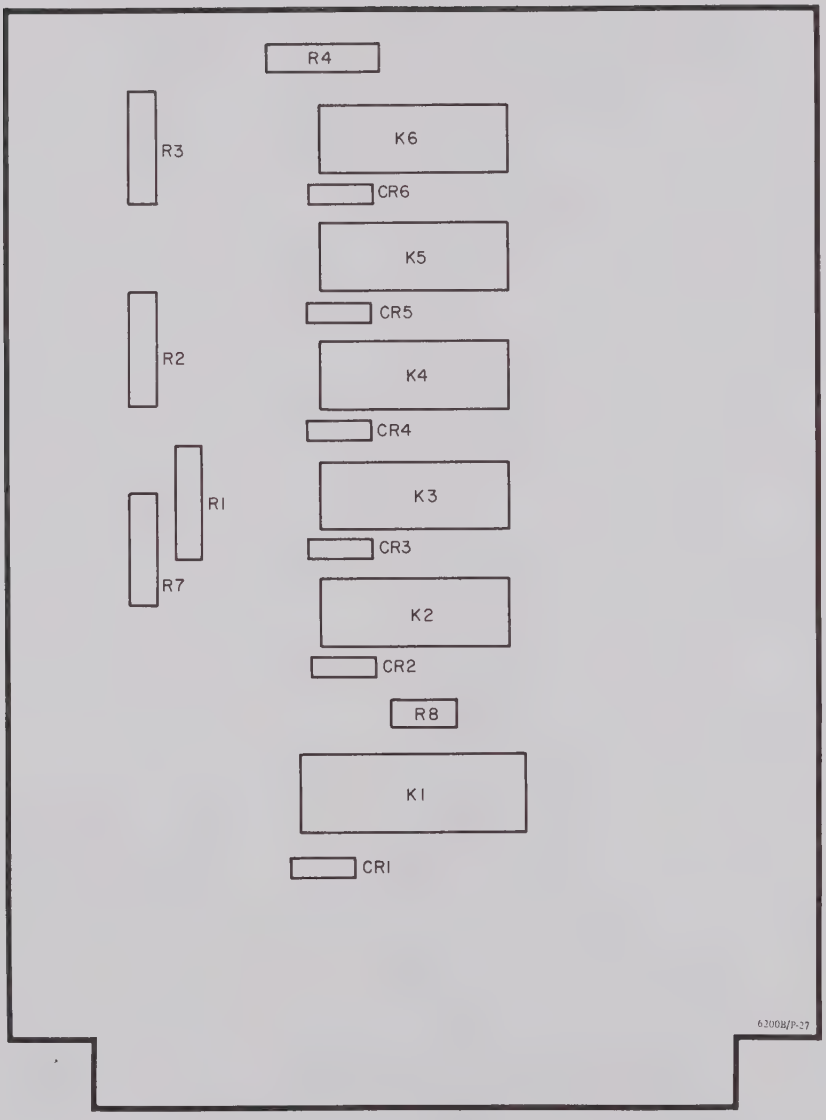
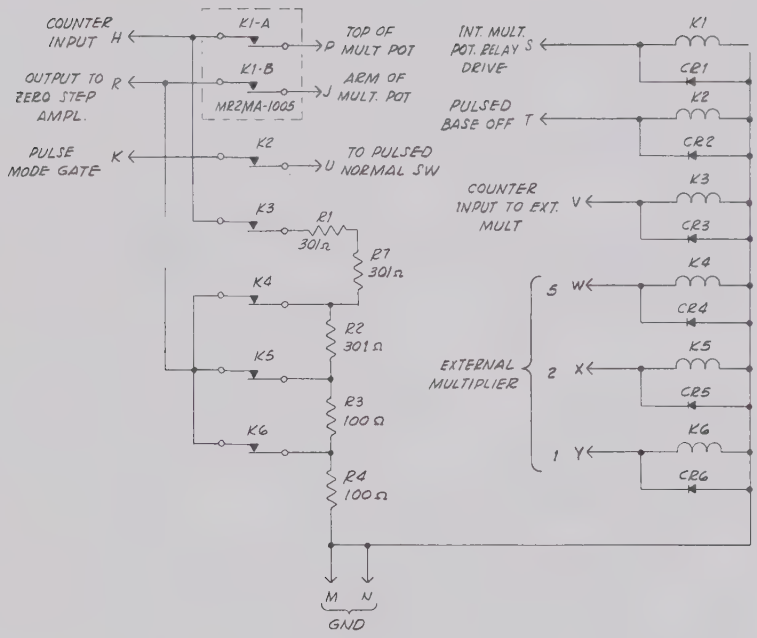


Figure 5-21. Component Location, Multiplier and Pulse Base Programer Assembly A9



3. ALL RELAYS TO BE MRMA-1003
2. ALL DIODES TO BE FD100
1. ALL RESISTORS TO BE 1/2W, 1%
NOTES: UNLESS OTHERWISE SPECIFIED

Figure 5-22. Schematic, Multiplier and Pulse Base Programer Assembly A9

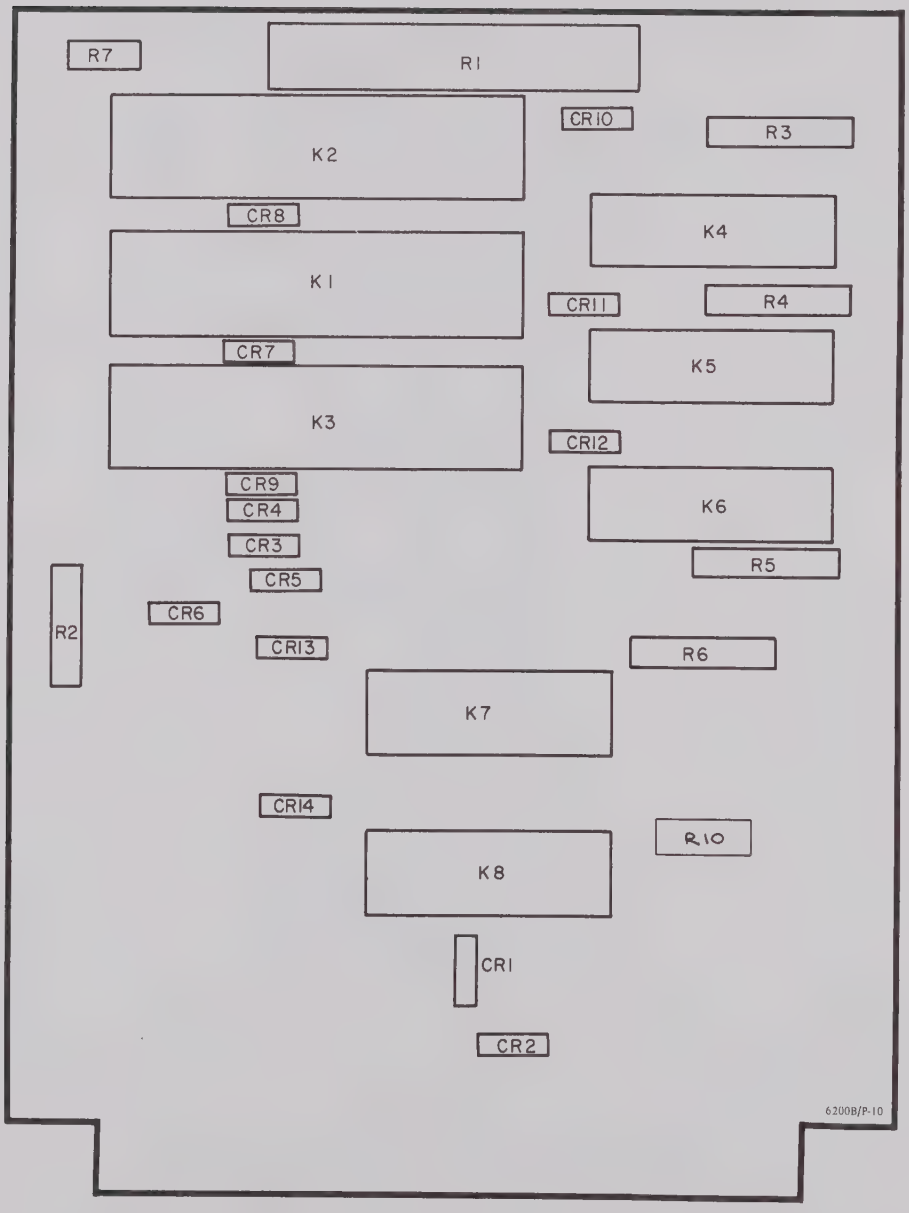


Figure 5-23. Component Location, Base Generator Programer Assembly A10

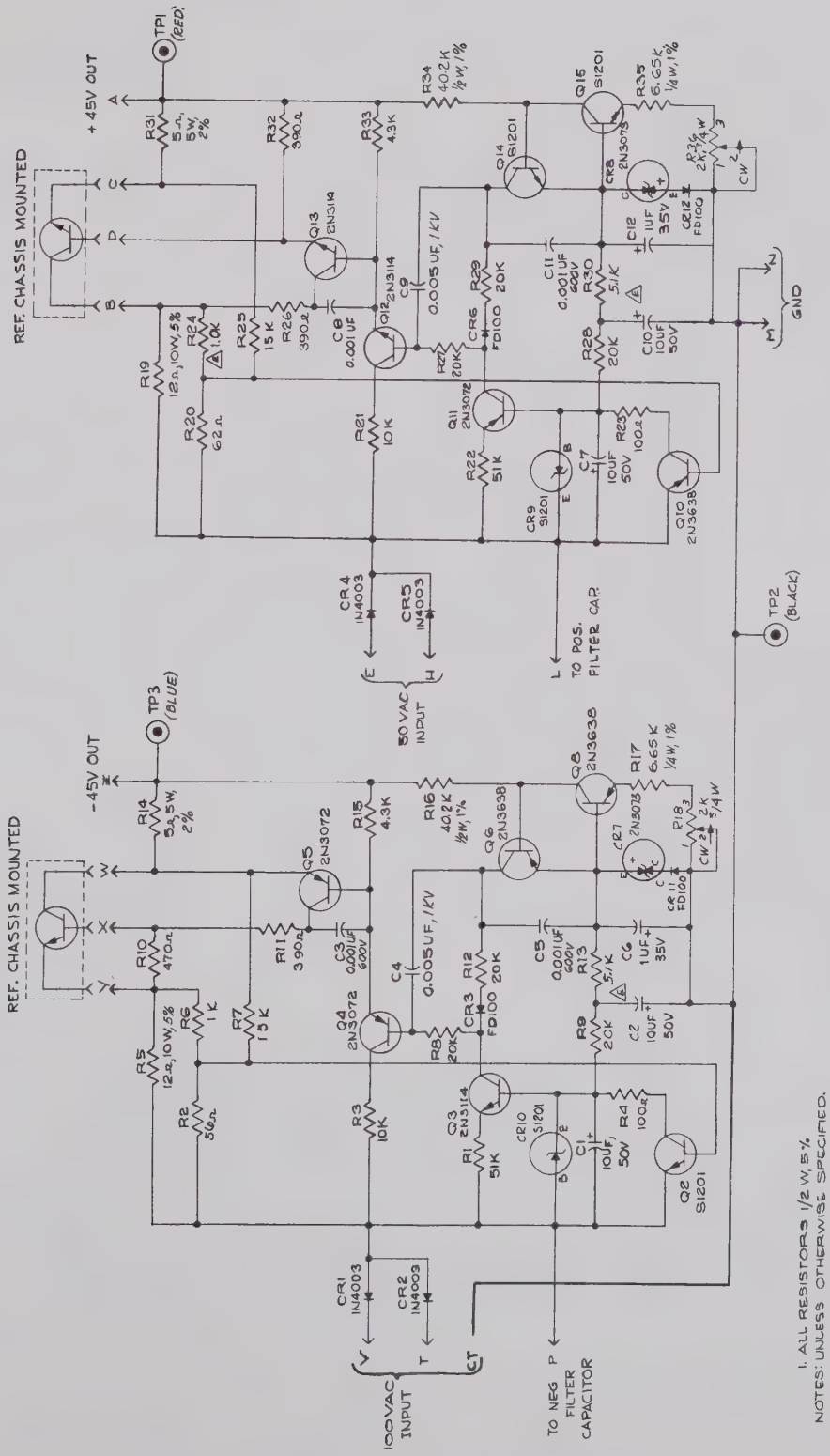


Figure 5-8. Schematic, ±45 V Power Supply Assembly A1

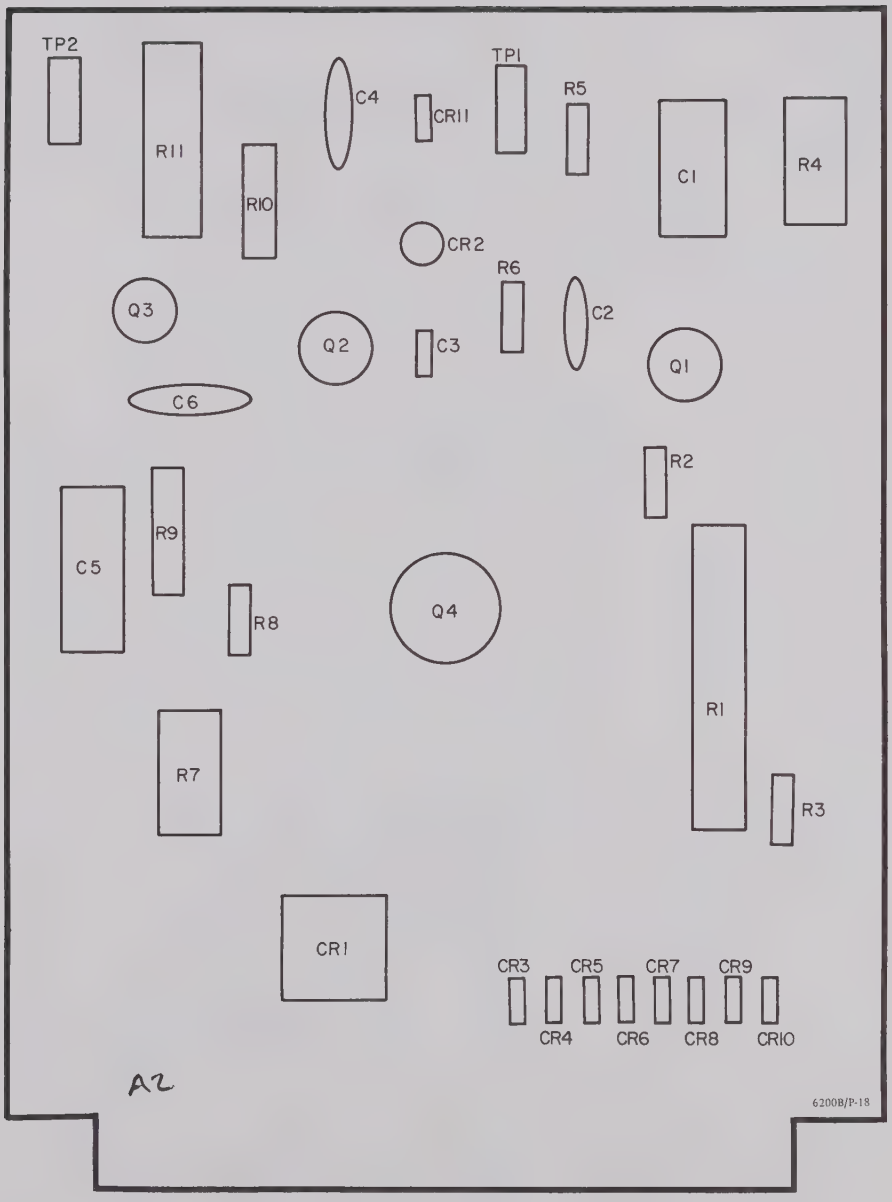


Figure 5-9. Component Location, +225 Volt Power Supply Assembly A2

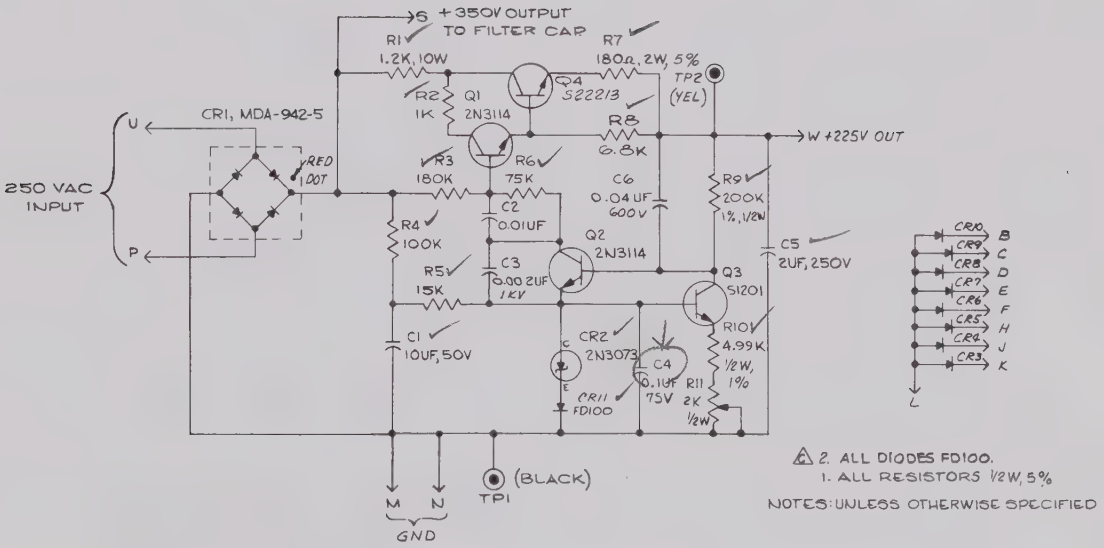


Figure 5-10. Schematic, +225 V Power Supply Assembly A2

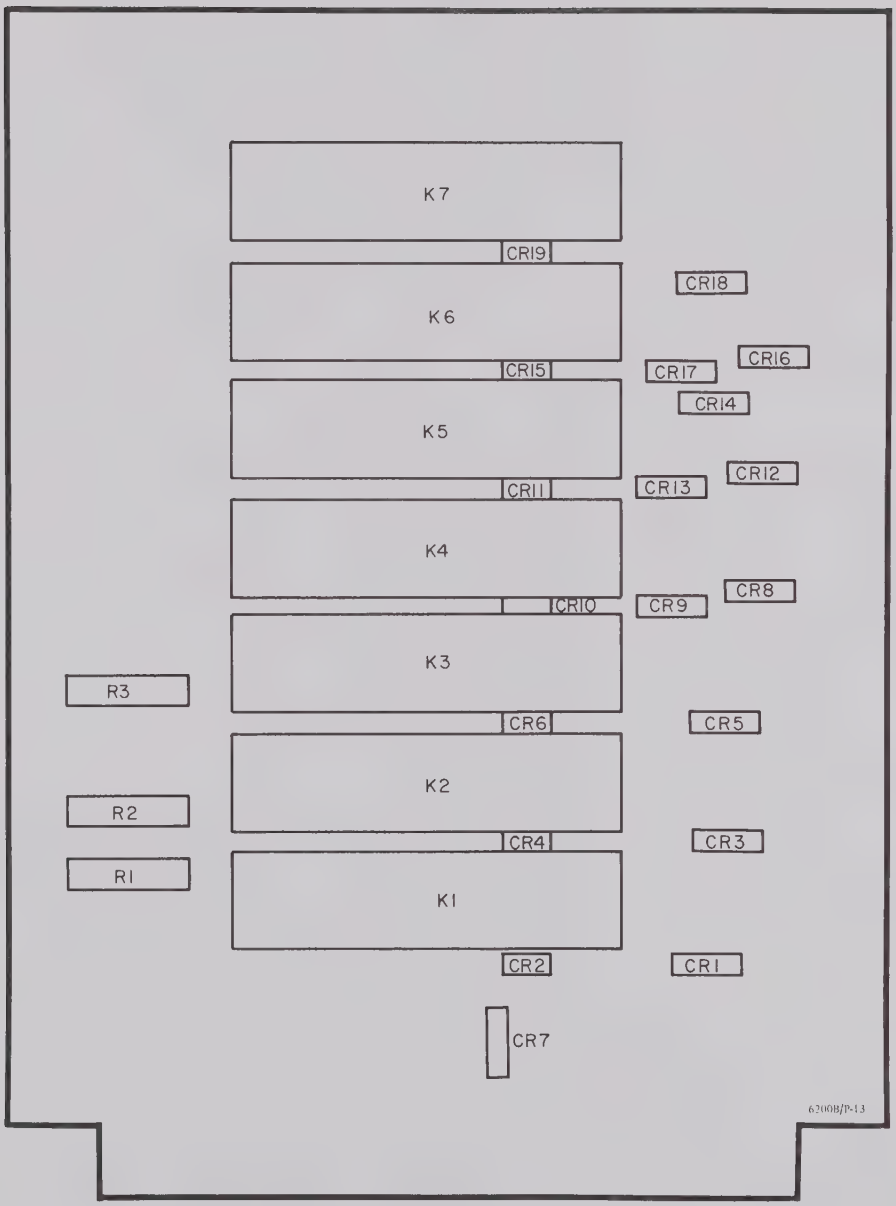
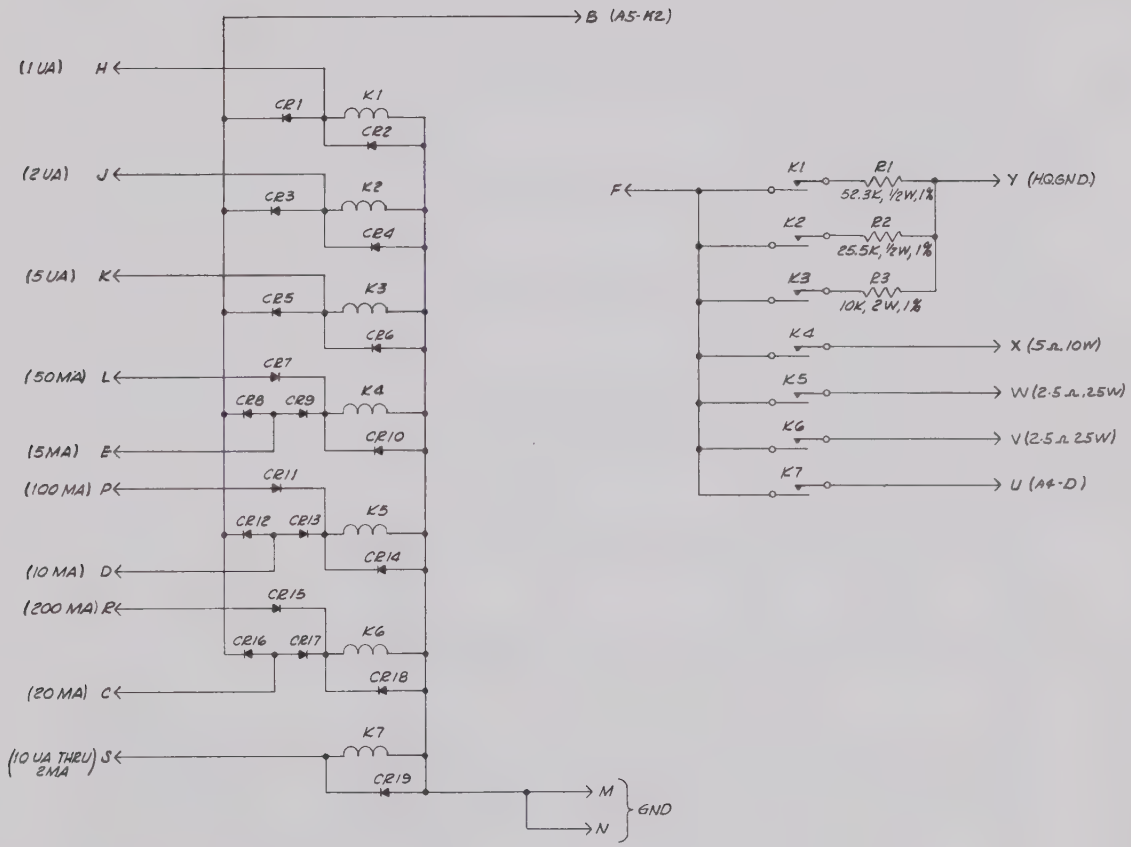


Figure 5-11. Component Location, Collector Current Relay Assembly A3



1. ALL DIODES ARE FD100

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 5-12. Schematic, Collector Current Relay Assembly A3

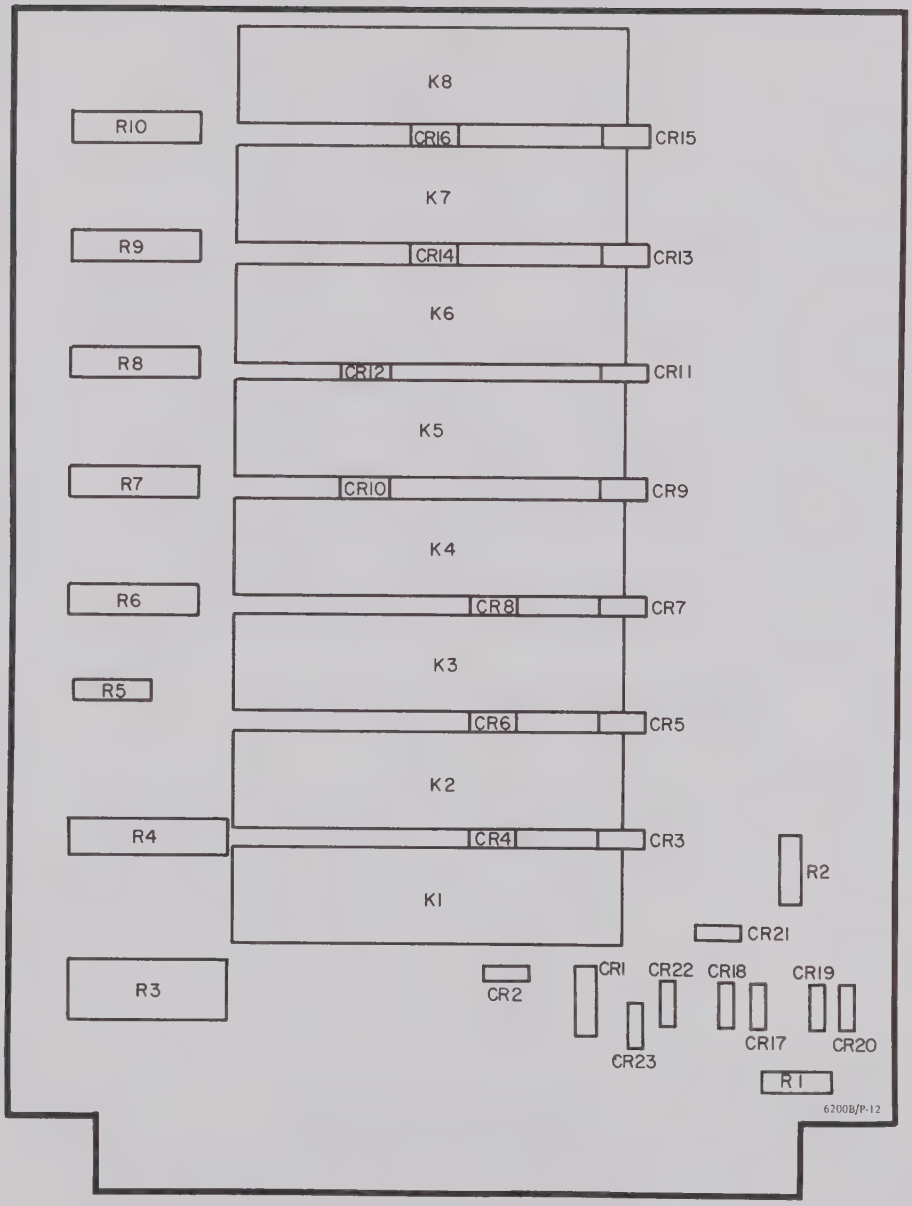
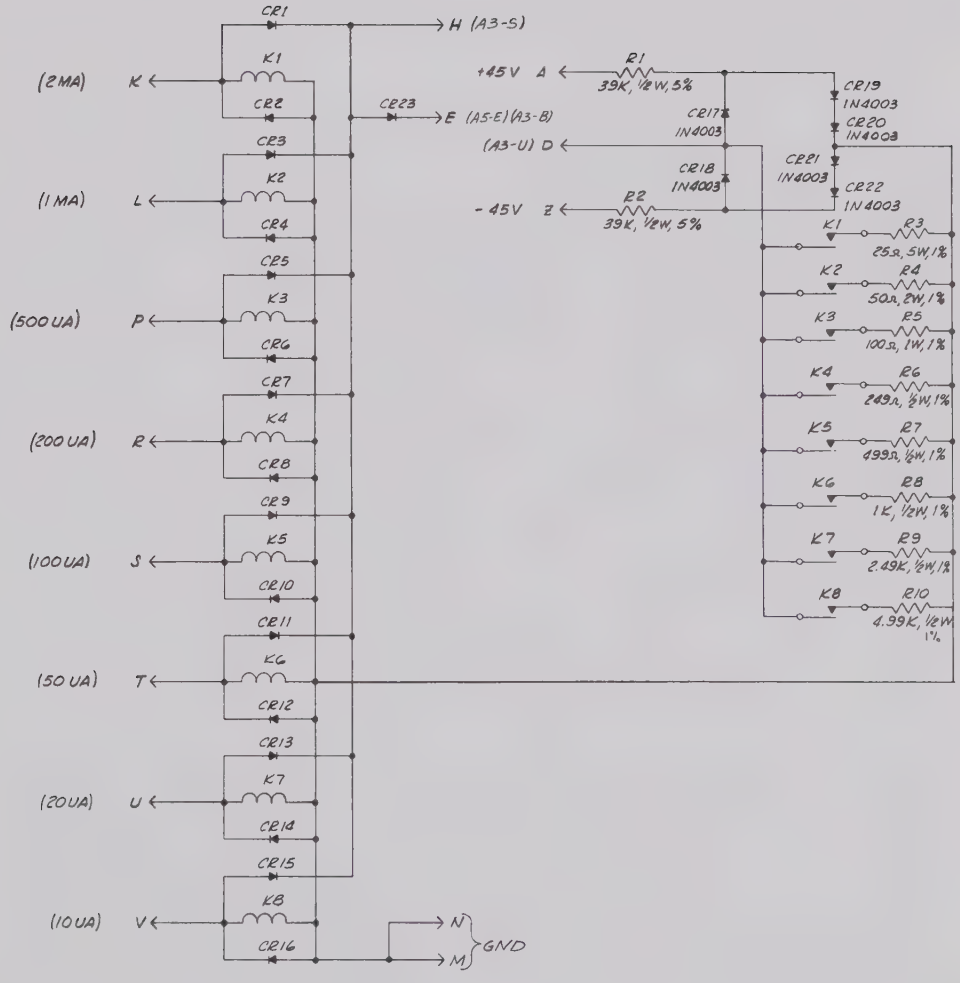


Figure 5-13. Component Location, Collector Current Relay Assembly A4



1. ALL DIODES ARE FD-100

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 5-14. Schematic, Collector Current Relay Assembly A4

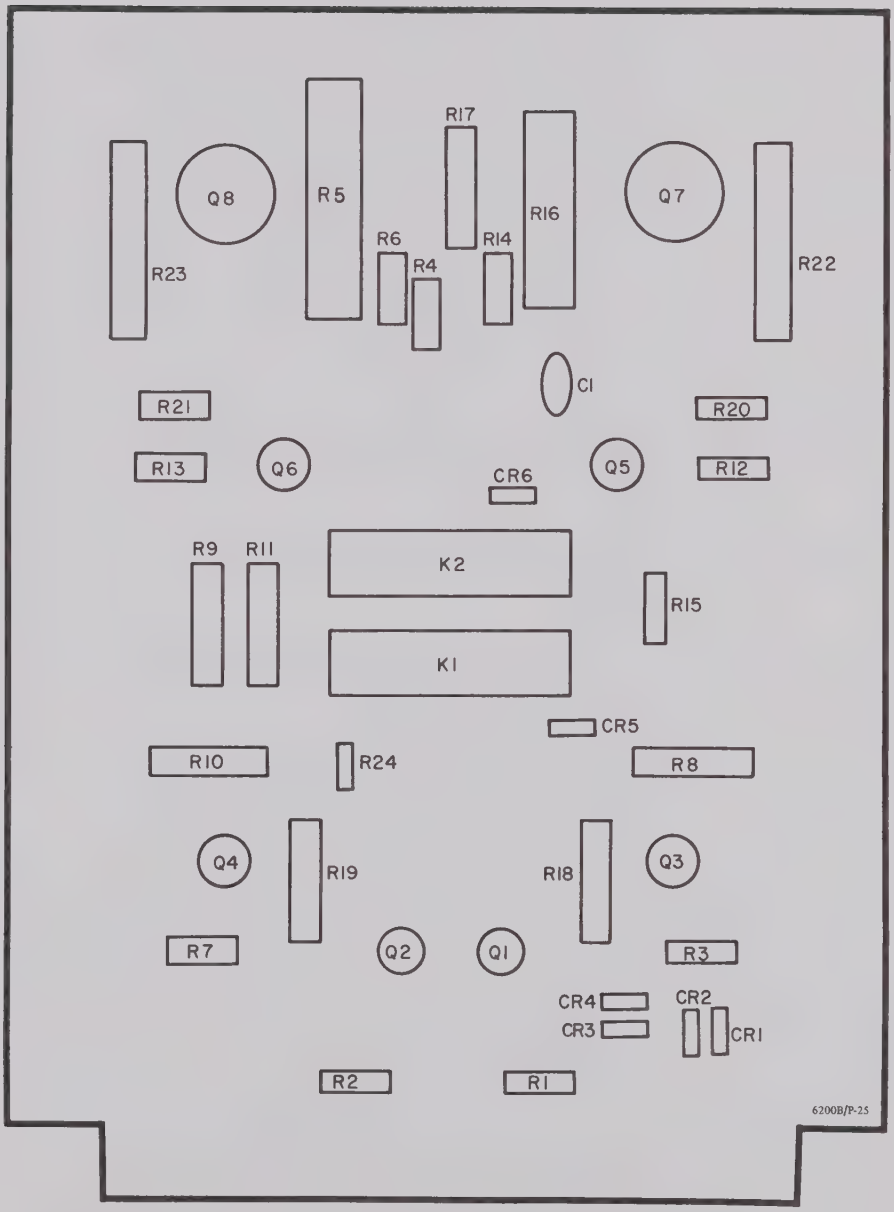


Figure 5-15. Component Location, Vertical Amplifier Assembly A5

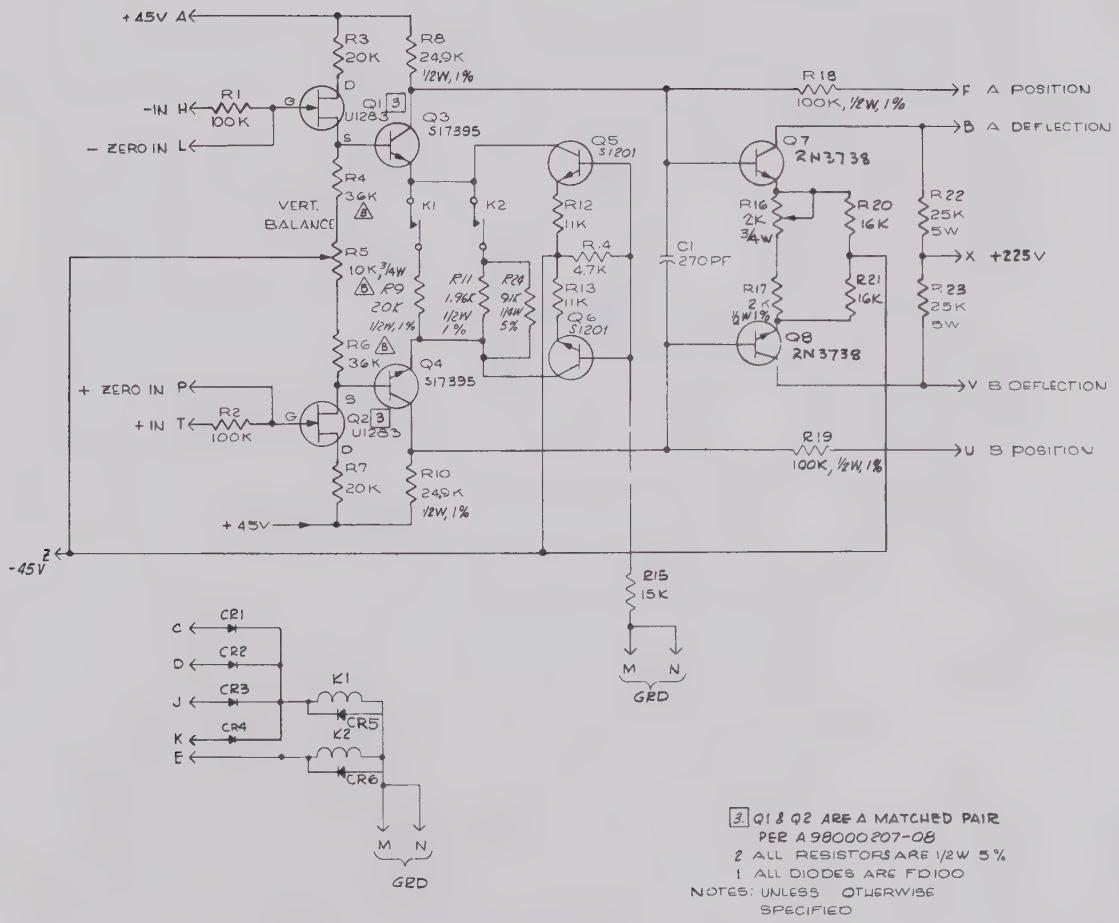


Figure 5-16. Vertical Amplifier Assembly A5

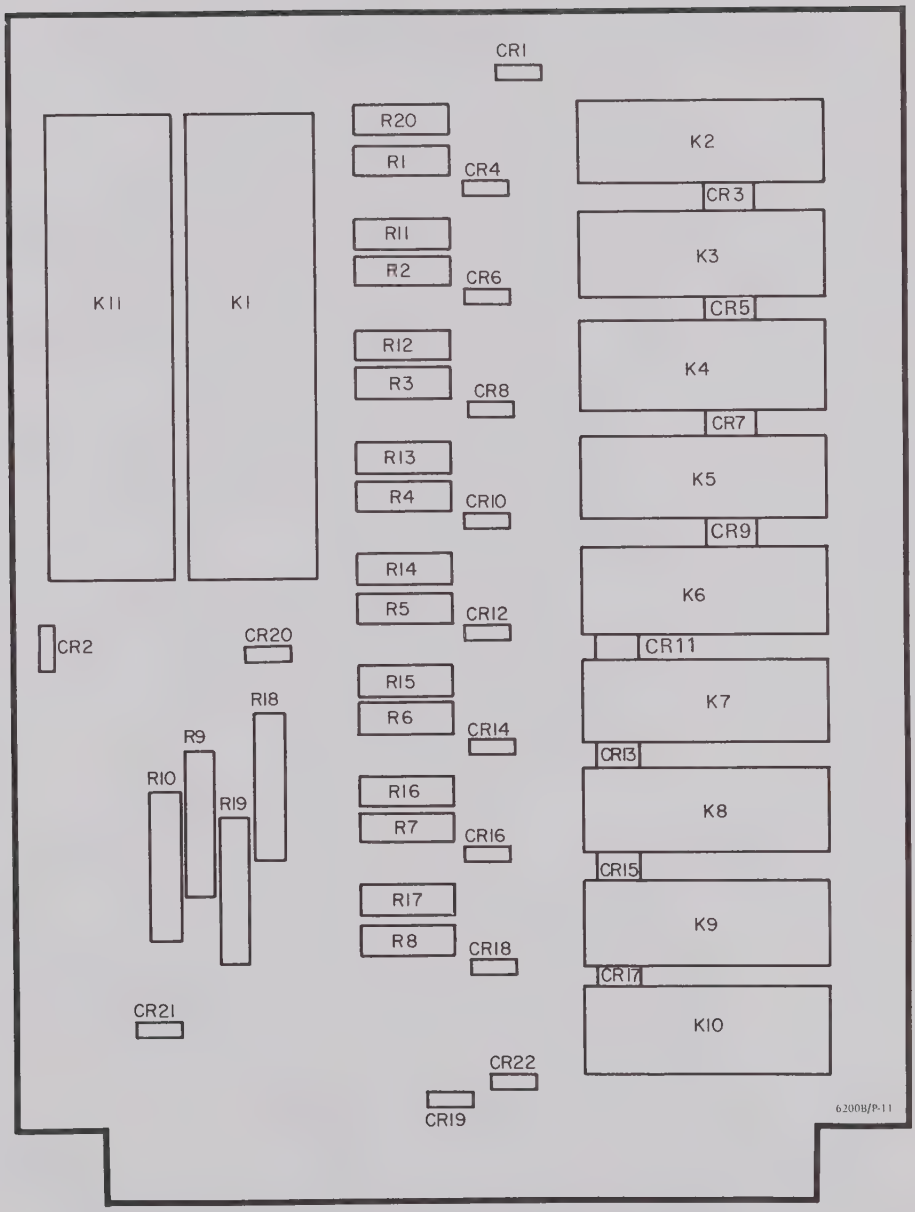


Figure 5-17. Component Location, Collector Voltage Relay Assembly A6

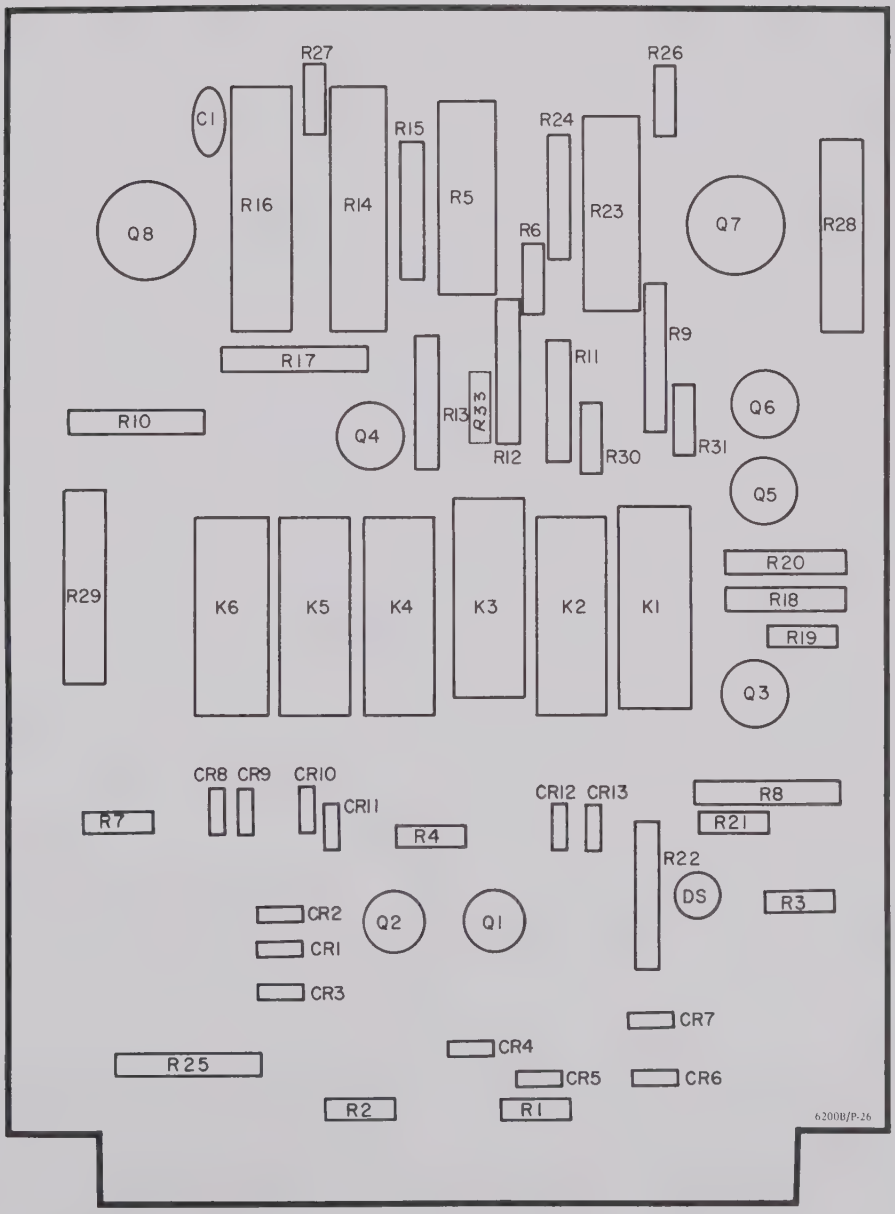


Figure 5-19. Component Location, Horizontal Amplifier Assembly A7

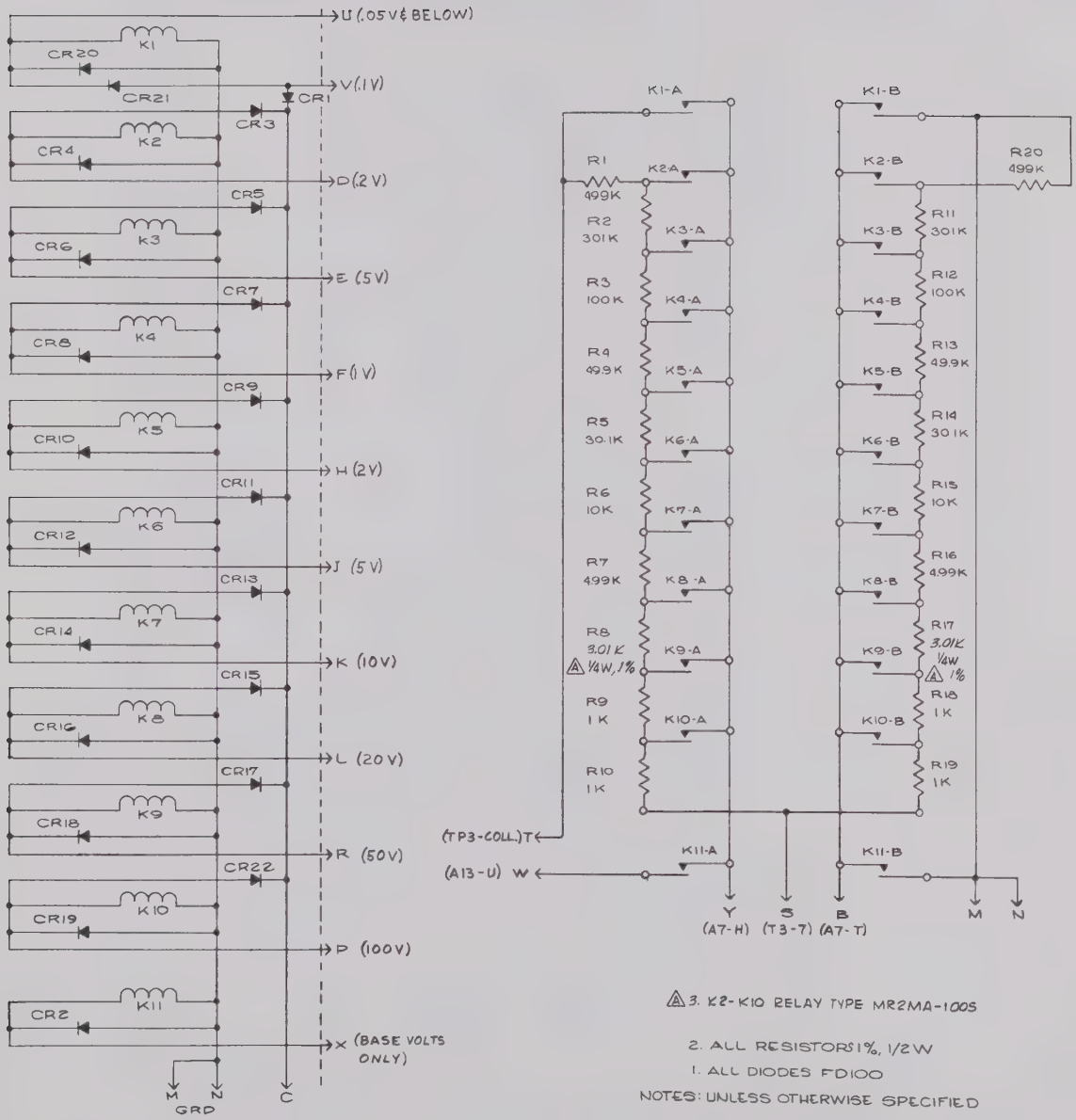


Figure 5-18. Schematic, Collector Voltage Relay Assembly A6

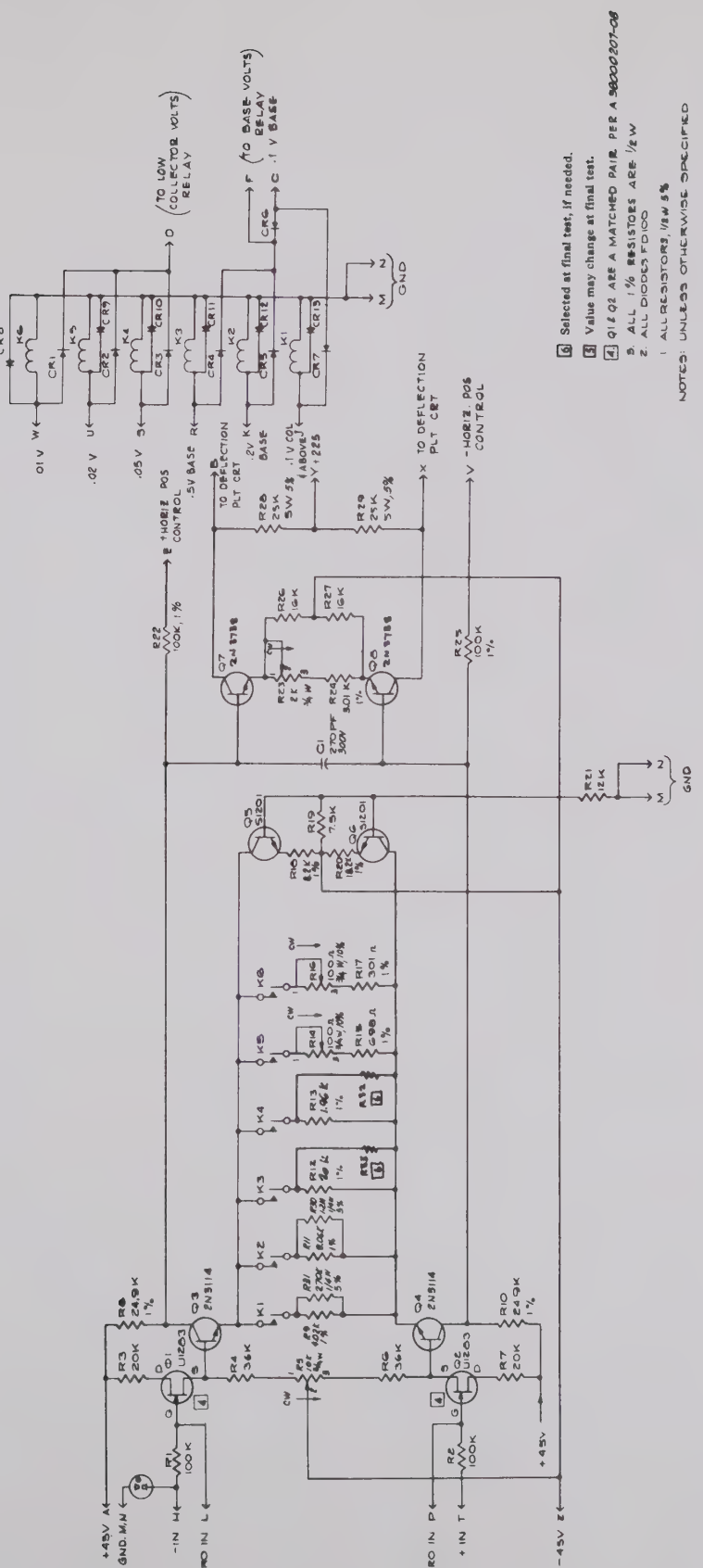


Figure 5-20. Horizontal Amplifier Assembly A7

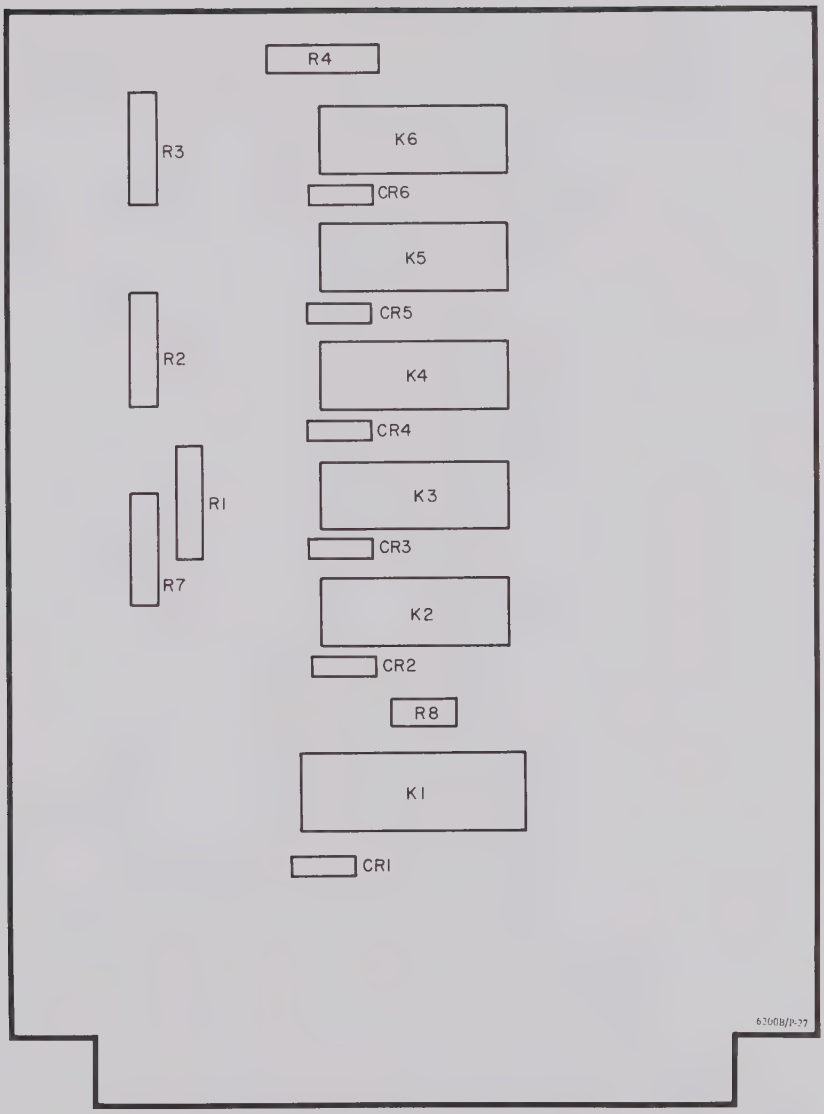
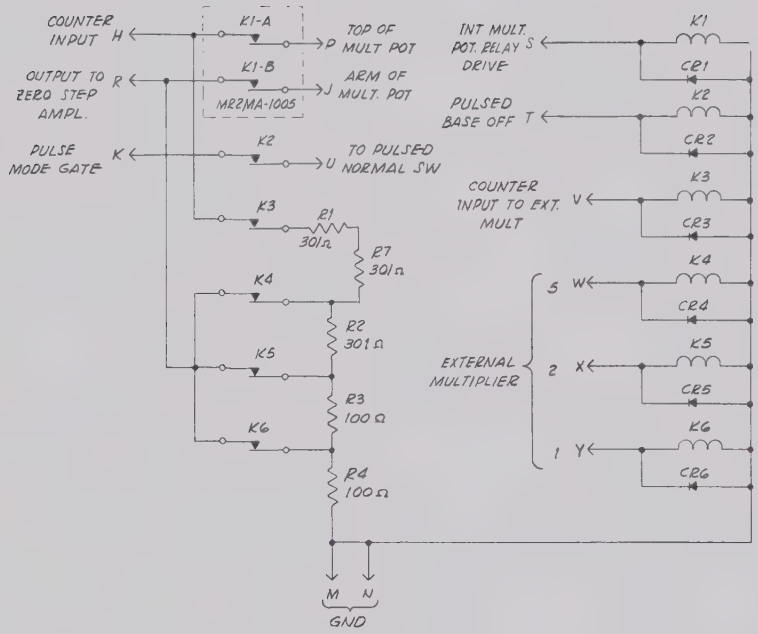


Figure 5-21. Component Location, Multiplier and Pulse Base Programer Assembly A9



3. ALL RELAYS TO BE MRMA-1003
2. ALL DIODES TO BE FD100
1. ALL RESISTORS TO BE 1/2W, 1%
NOTES: UNLESS OTHERWISE SPECIFIED

Figure 5-22. Schematic, Multiplier and Pulse Base Programer Assembly A9

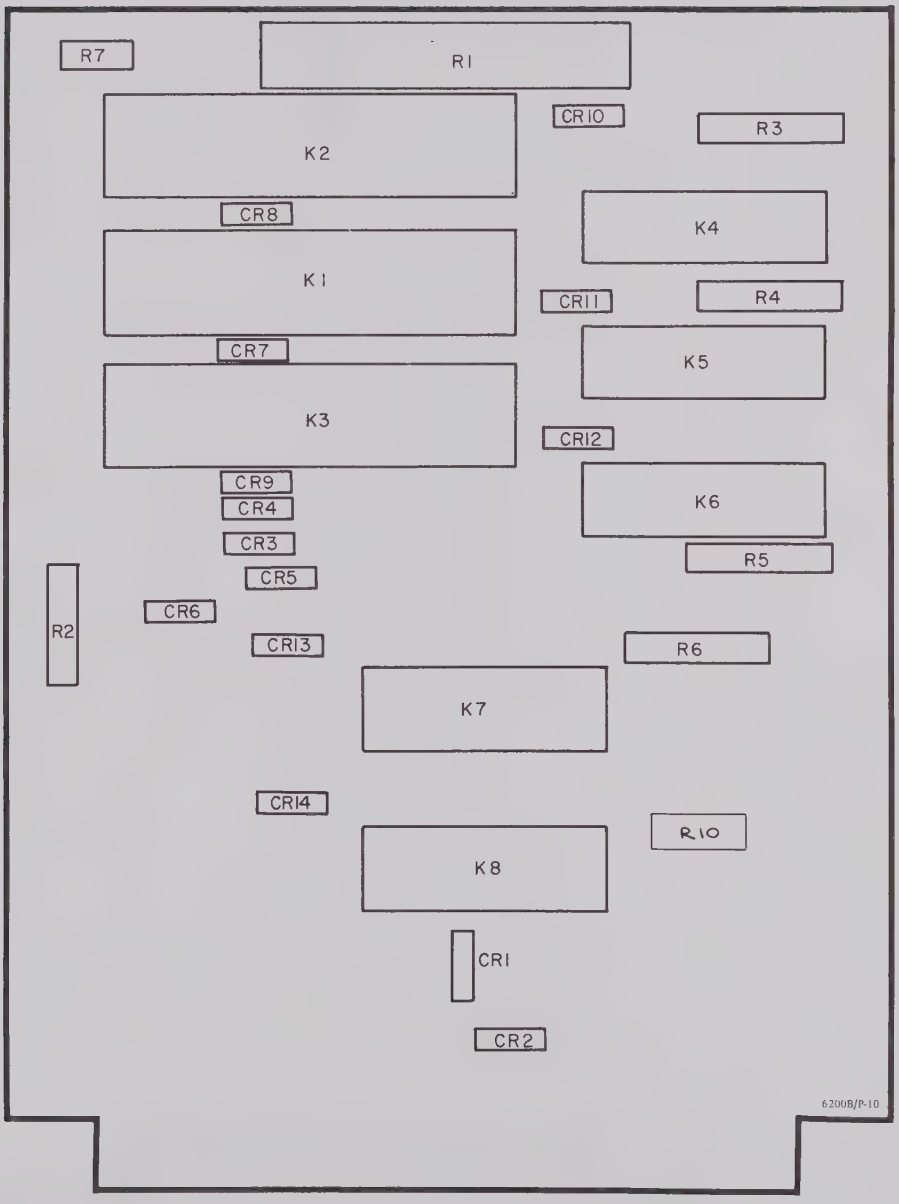
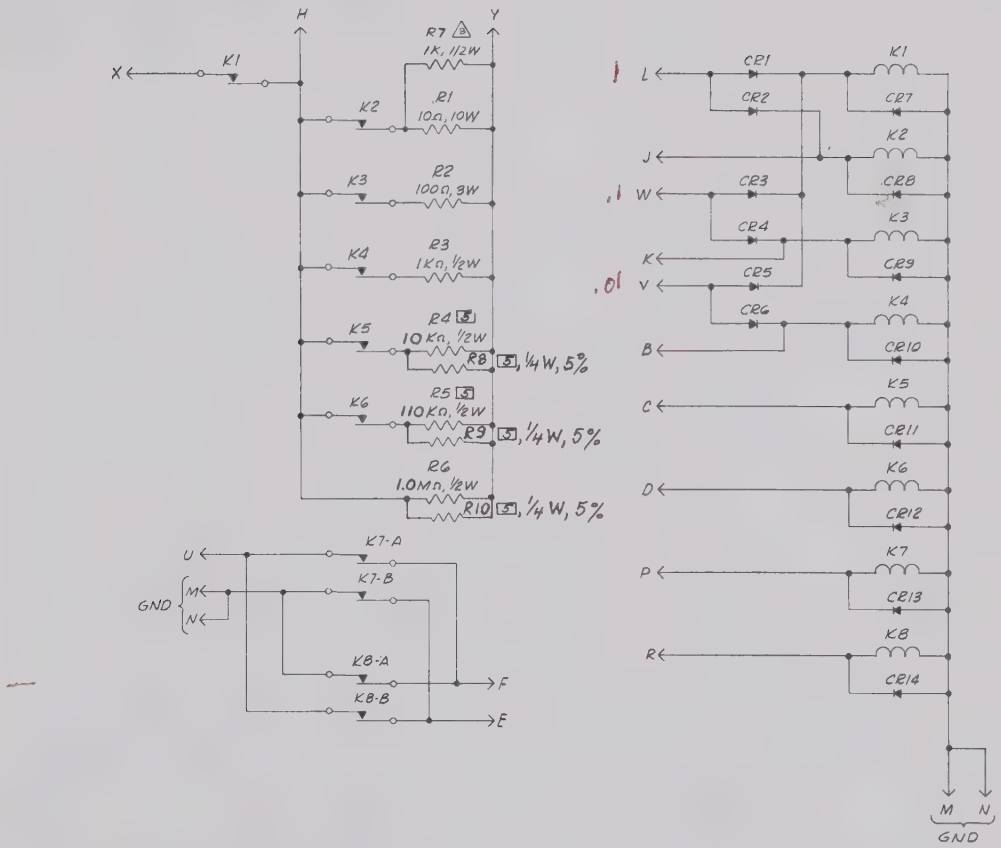


Figure 5-23. Component Location, Base Generator Programer Assembly A10



[5] FACTORY SELECT.
⚠4 K4,5&6 RELAY, MR2MA-1003
⚠3. K7&K8 RELAY, MR2MA-1005
2. ALL DIODES TO BE FD100
1. ALL RESISTORS TO BE 1%

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 5-24. Schematic, Base Generator Programer Assembly A10

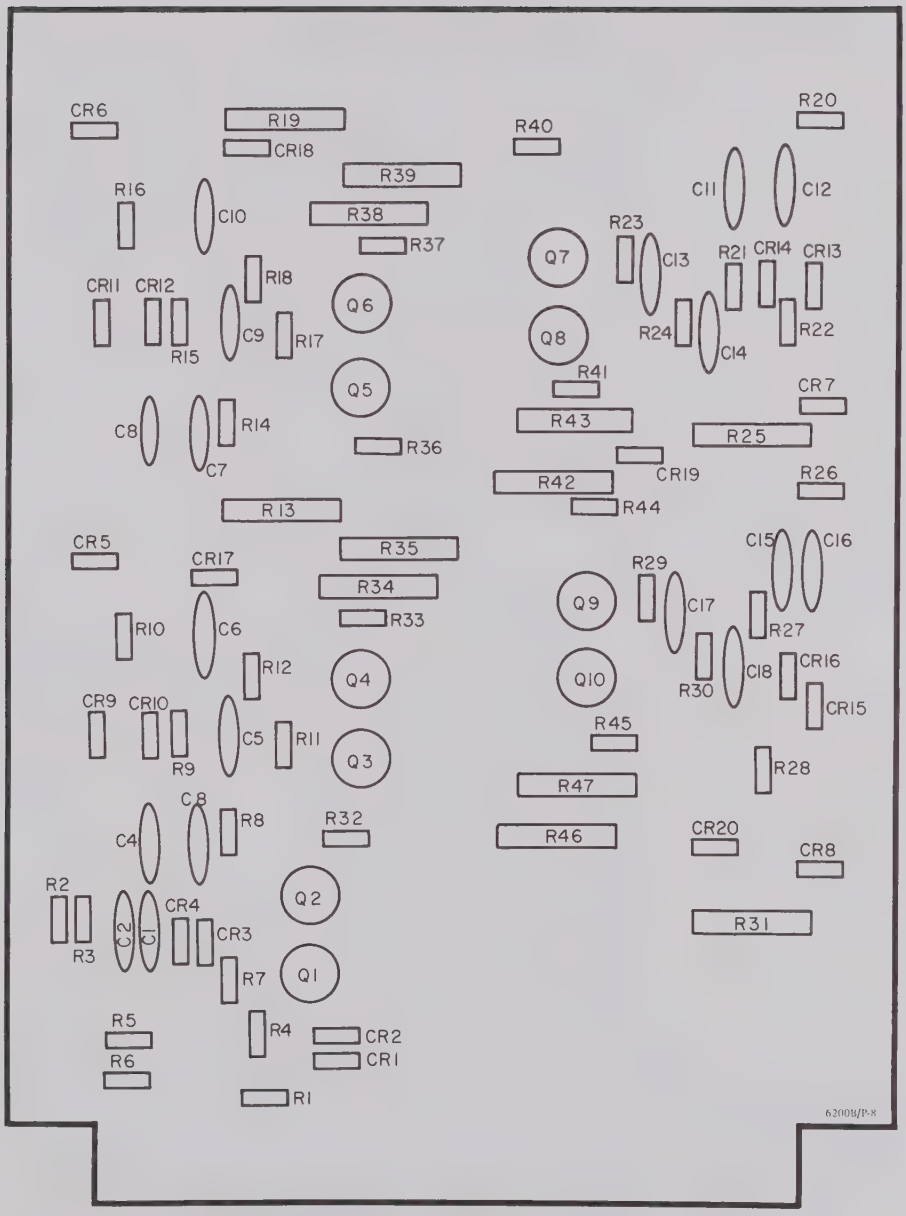


Figure 5-25. Component Location, Base Step Counter Assembly A11

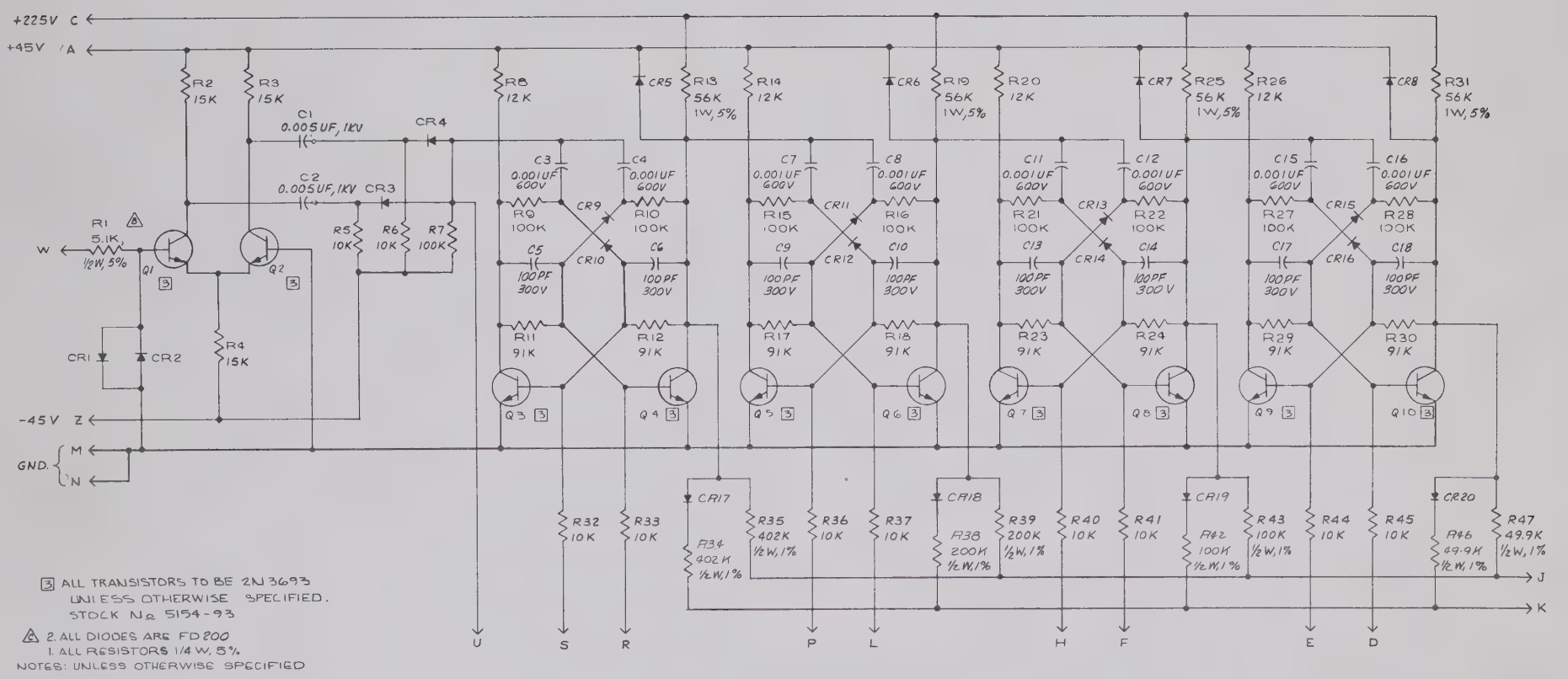


Figure 5-26. Schematic, Base Step Counter Assembly A11

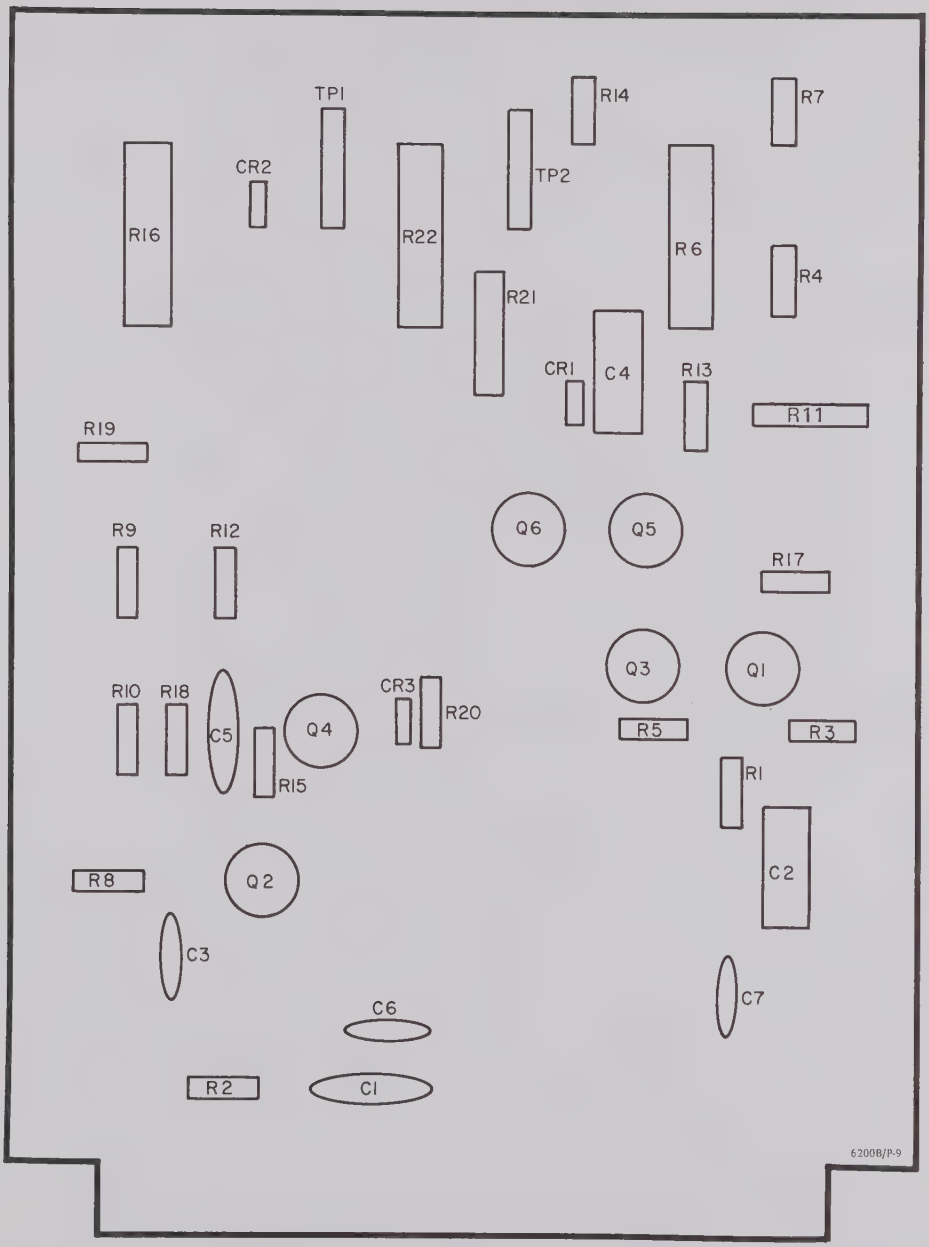


Figure 5-27. Component Location, Pulse Base and Last Step Reset Assembly A12

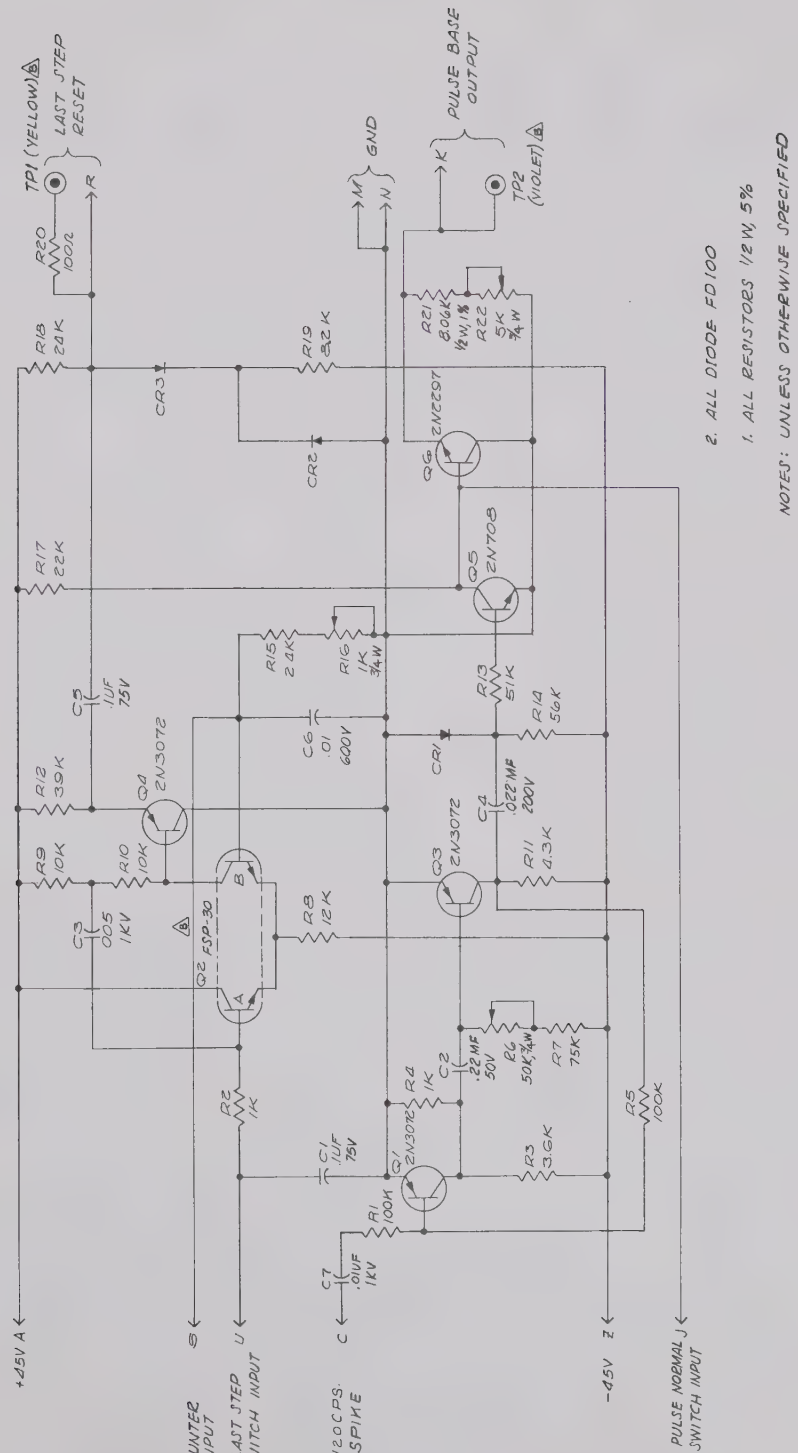


Figure 5-28. Schematic, Pulse Base and Last Step Reset Assembly A12

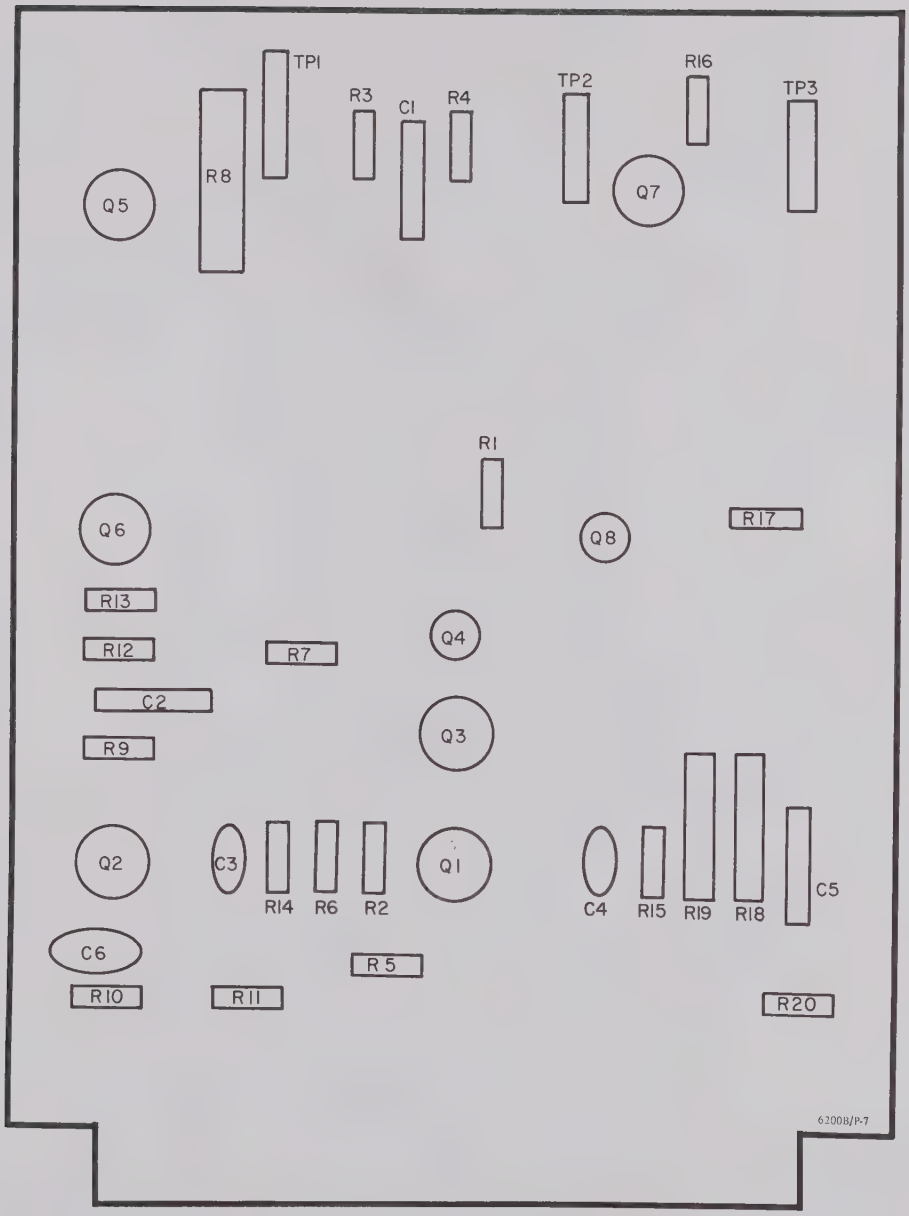


Figure 5-29. Component Location, Feedback Amplifier and Zero Step Assembly A13

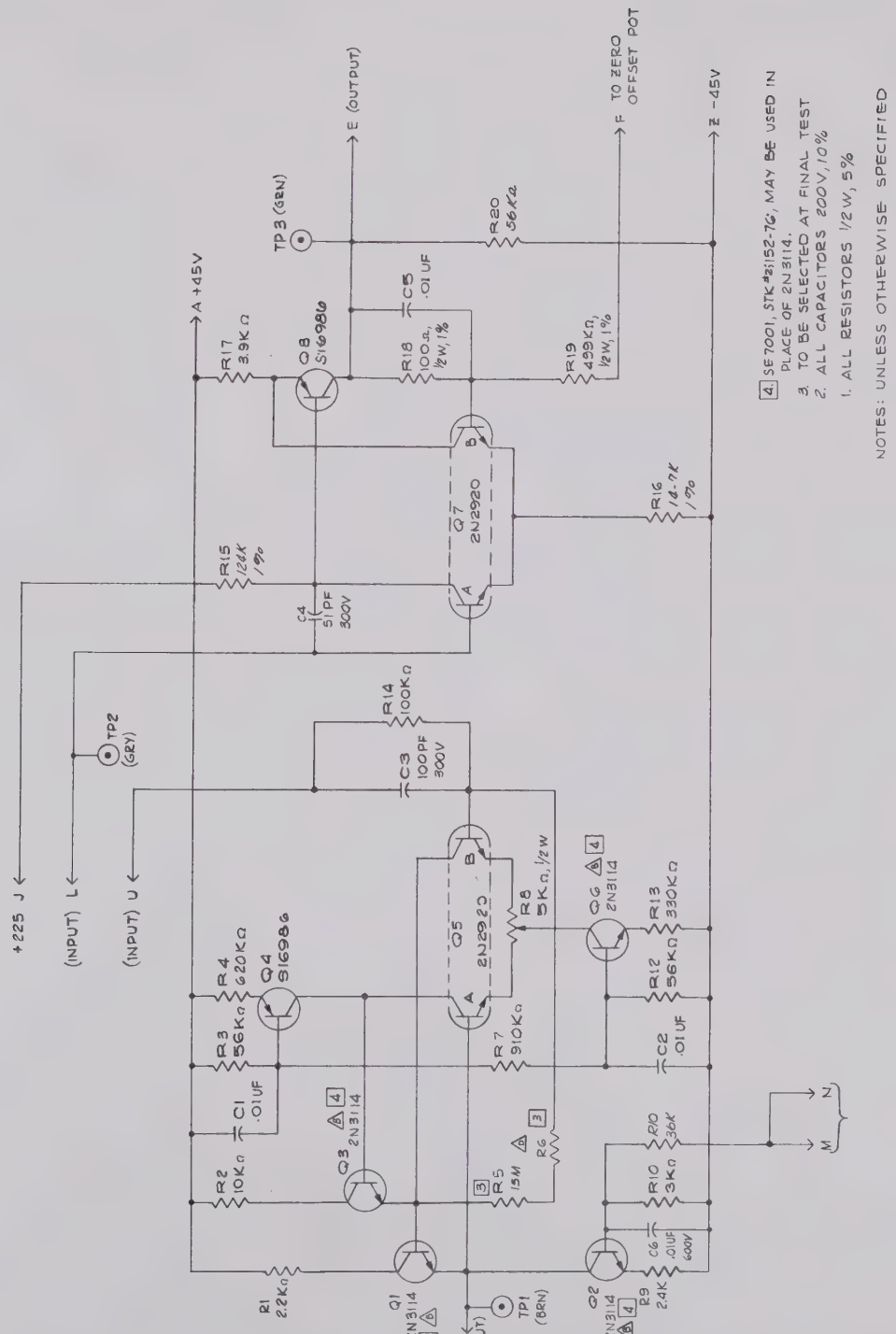


Figure 5-30. Schematic, Feedback Amplifier and Zero Step Assembly A13

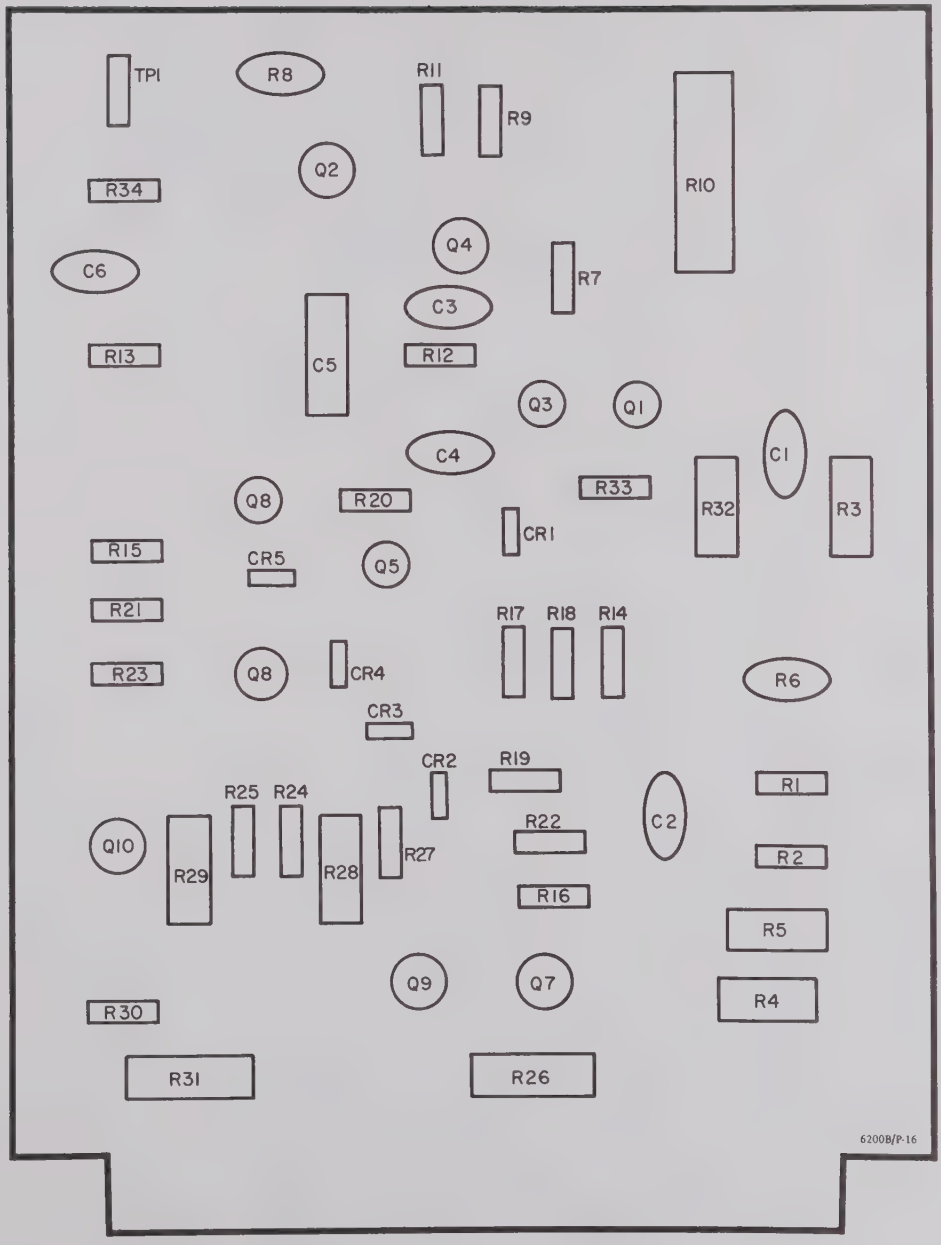


Figure 5-31. Component Location, Base Step Amplifier Assembly A14

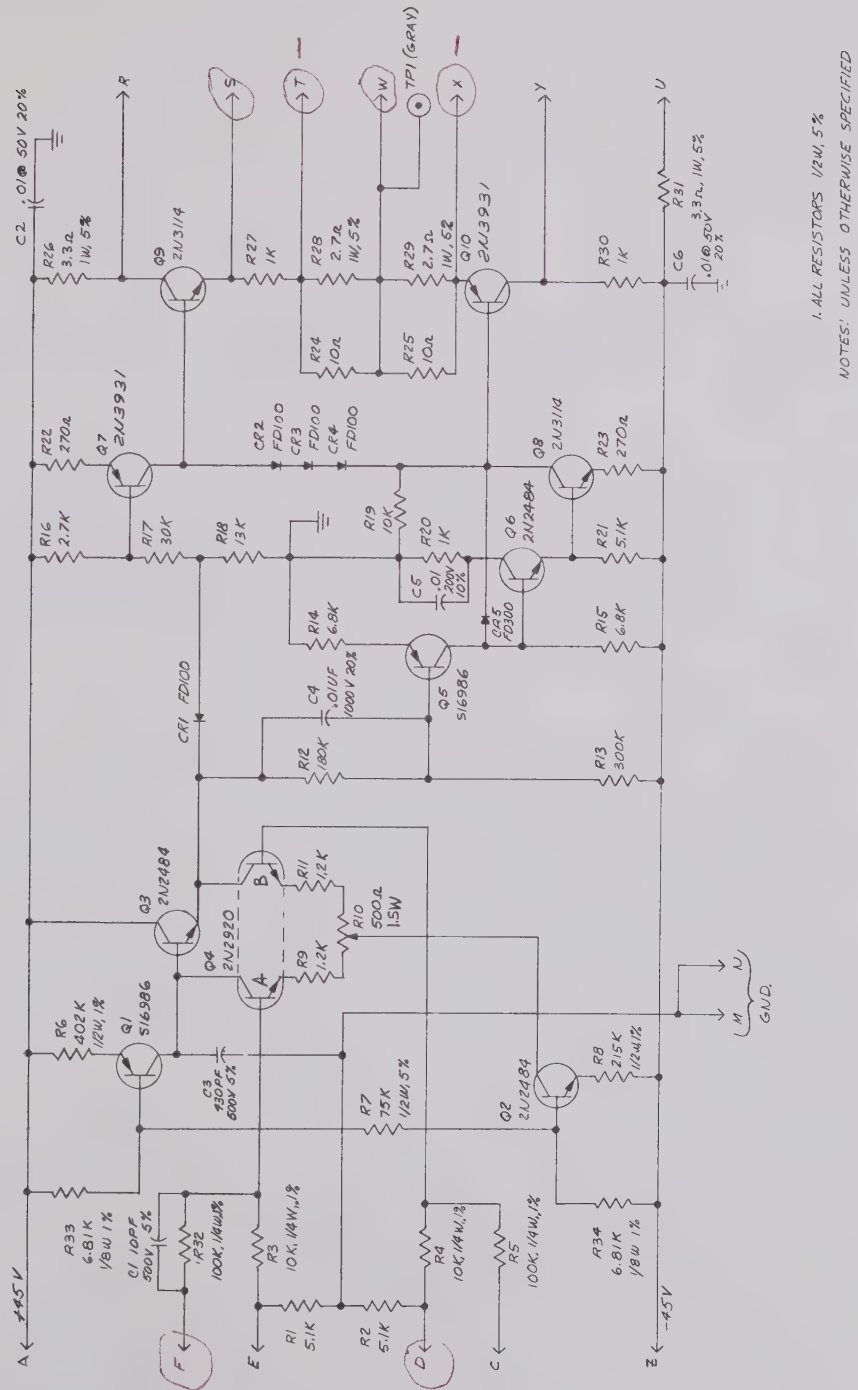


Figure 5-32. Schematic, Base Step Amplifier Assembly A14

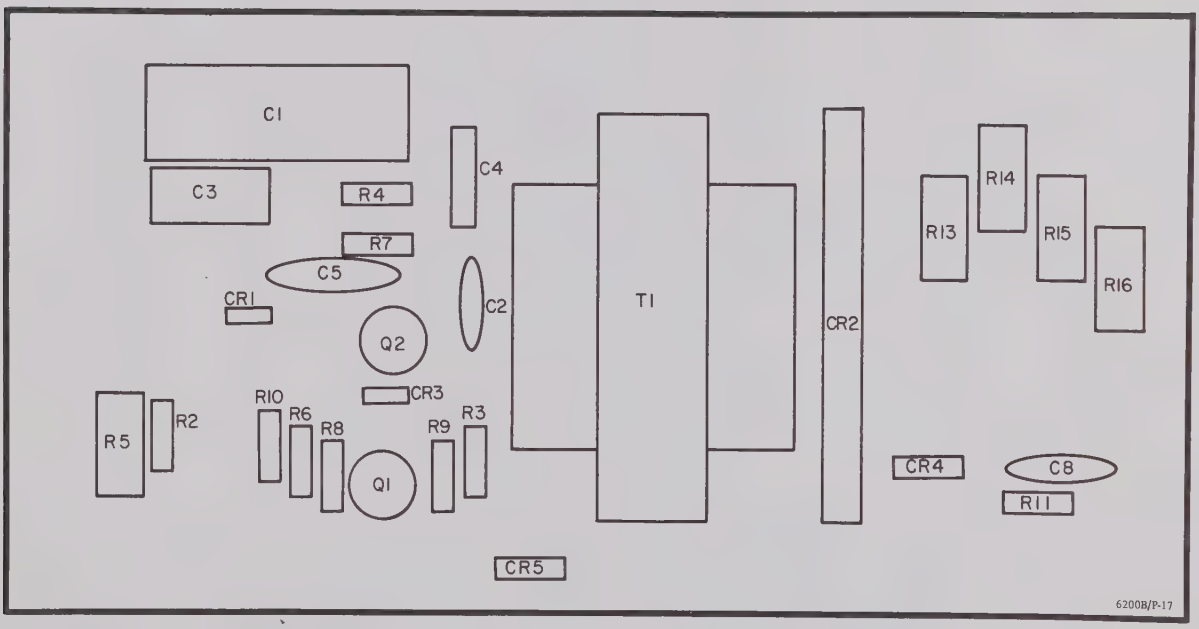
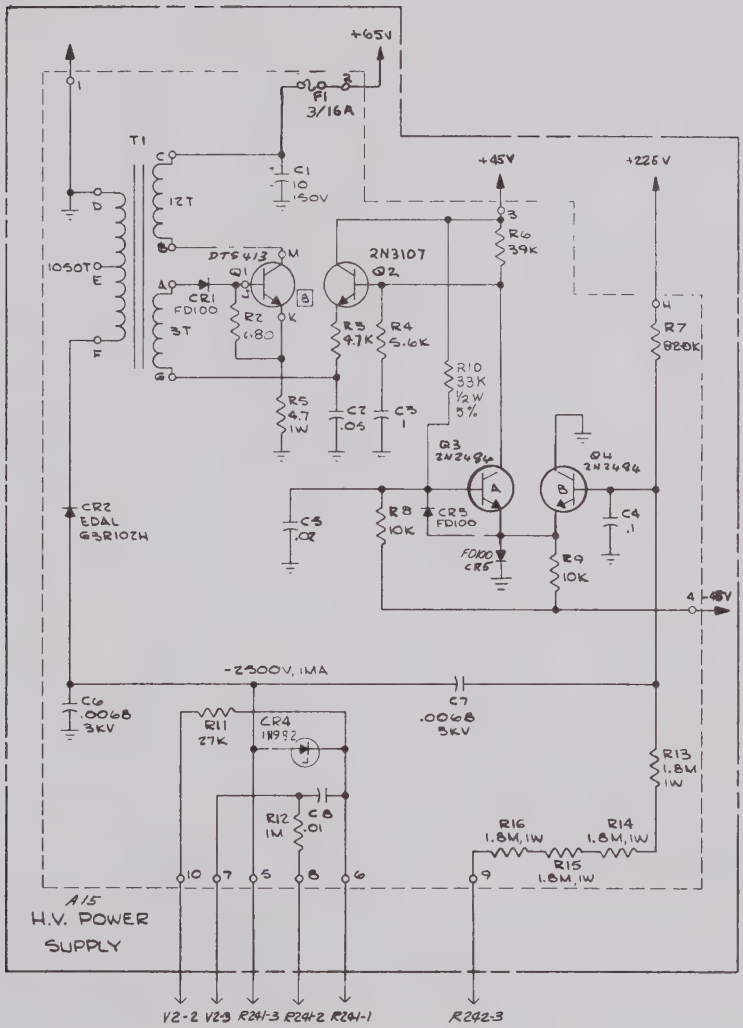


Figure 5-33. Component Location, High Voltage Power Supply Assembly A15



1. ALL RESISTORS ½W, 5W

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 5-34. Schematic, High Voltage Power Supply Assembly A15

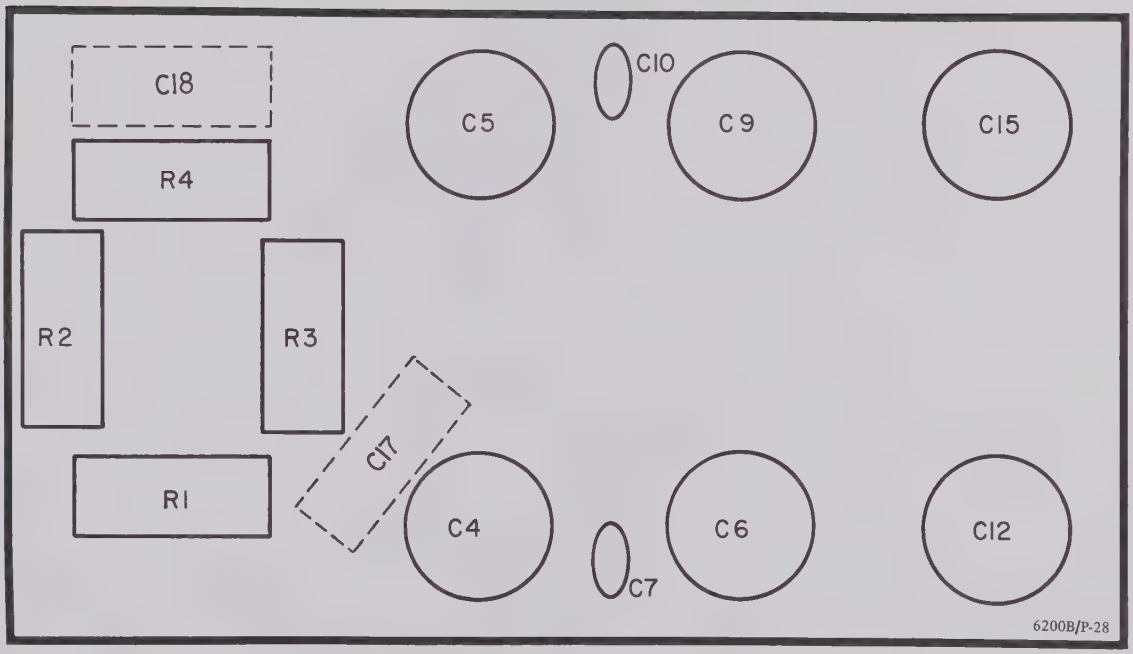
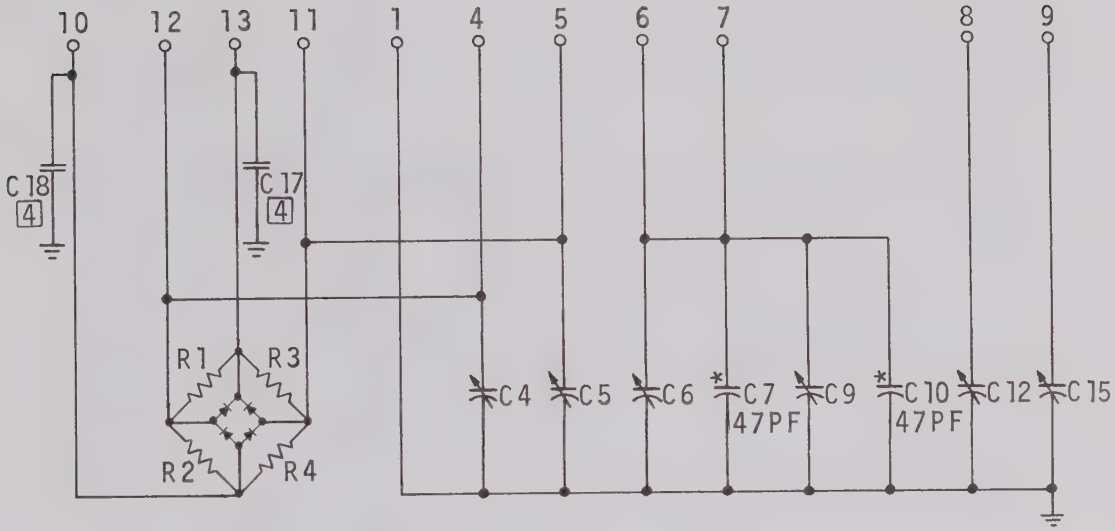


Figure 5-35. Component Location, Sweep Rectifier Assembly A16



NOTE: UNLESS OTHERWISE SPECIFIED -

*1. CAPACITANCE VALUE ARE NOMINAL - SUBJECT TO CHANGE IN FINAL TEST OF INSTRUMENT.

[2.] MARK STOCK NUMBER APPROX. WHERE SHOWN WITH APPROPRIATE REVISION STATUS.

3. TRIMMER CAP. 7-45 PF, STOCK NO. 5302-44 MAY BE USED AS SUBSTITUTE.

[4.] FACTORY SELECT.

Figure 5-36. Schematic, Sweep Rectifier Assembly A16

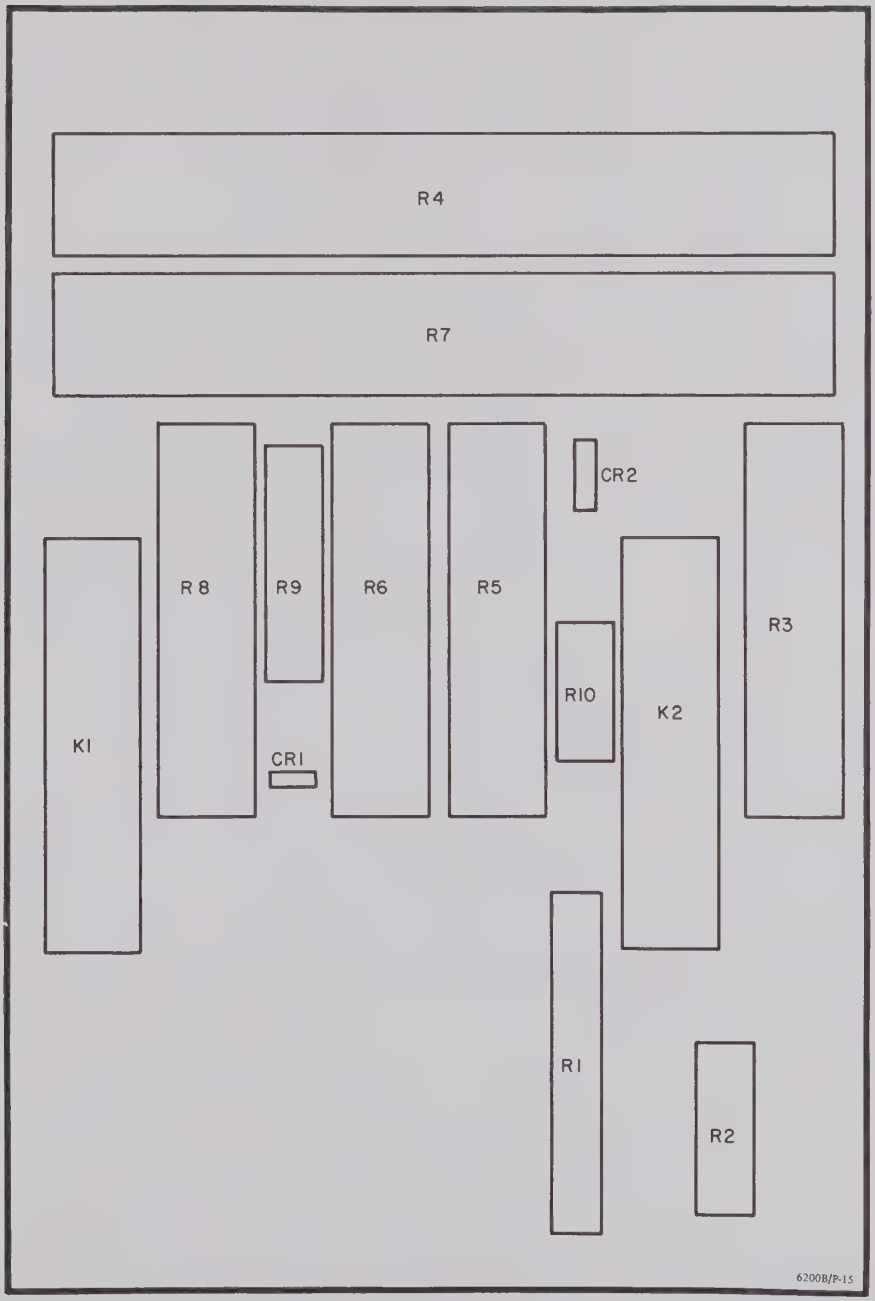


Figure 5-37. Component Location, Load Resistor Assembly A17

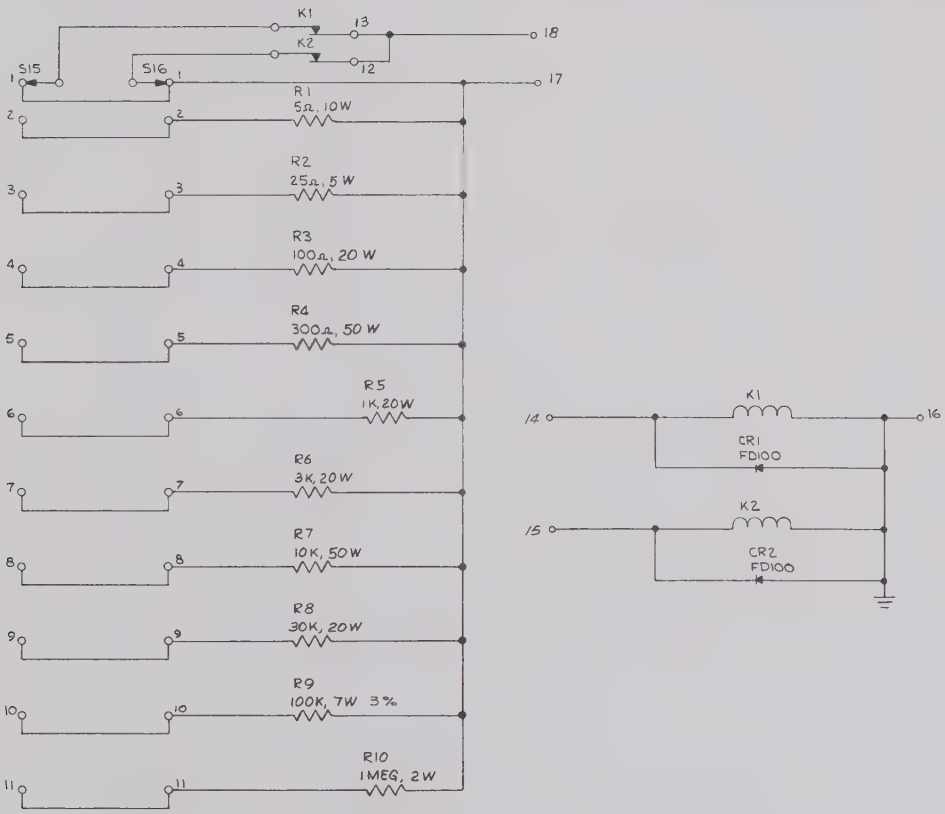


Figure 5-38. Schematic, Load Resistor Assembly A17

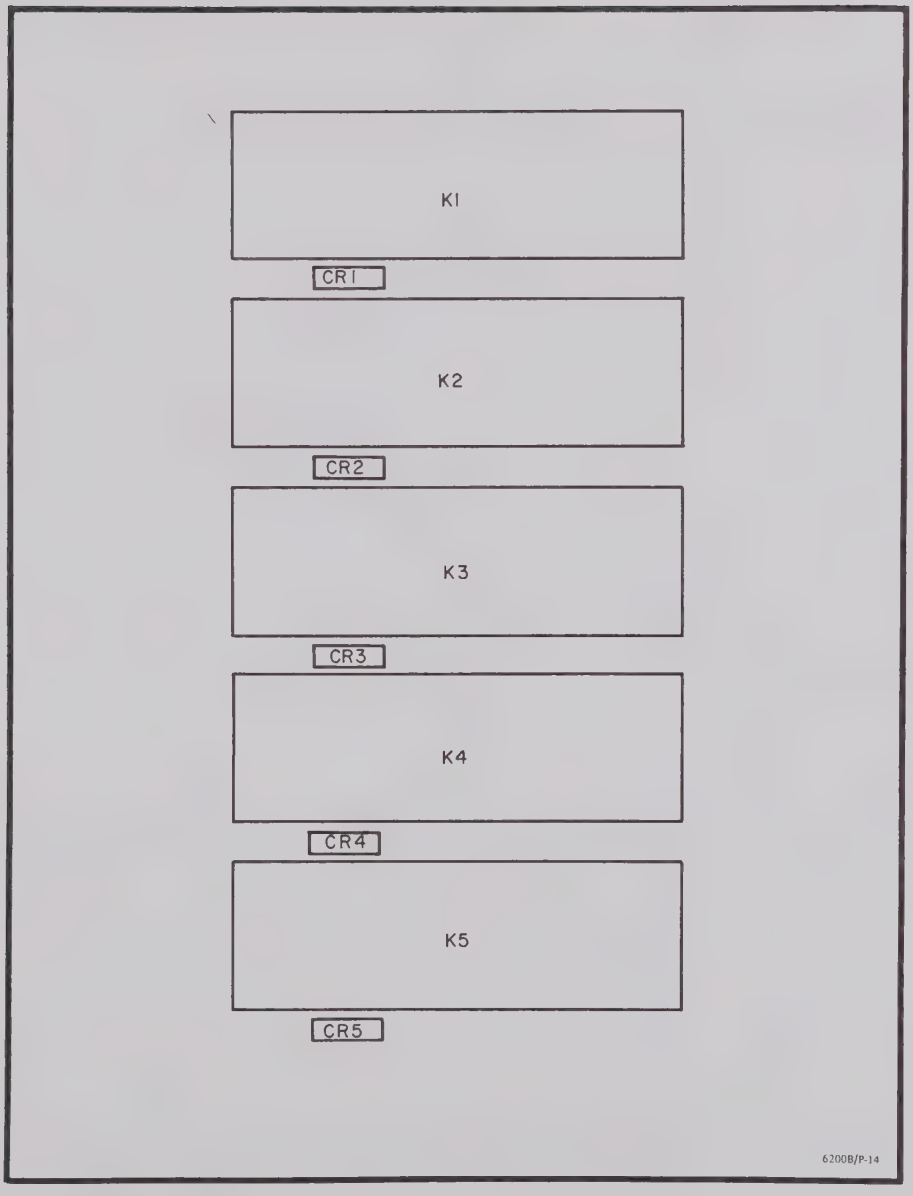
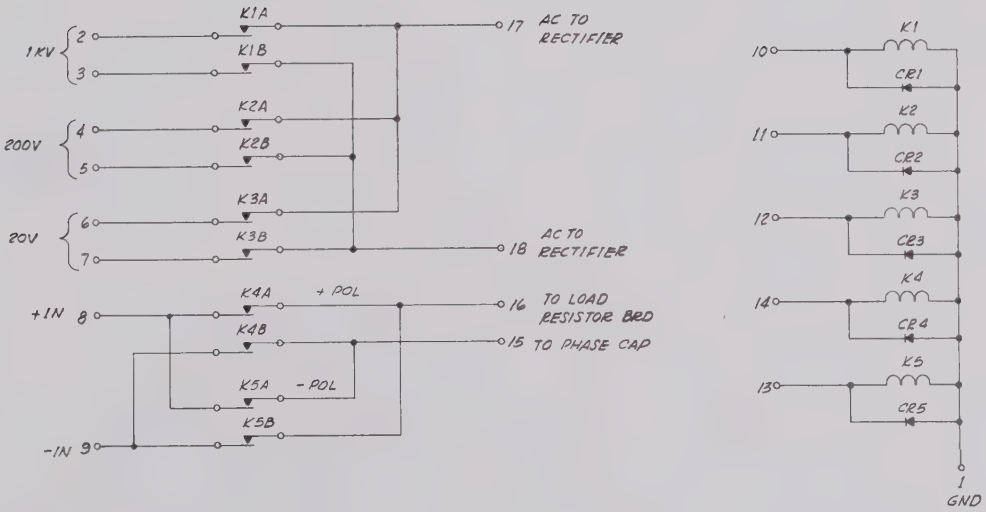


Figure 5-39. Component Location, Collector Programing Relay Assembly A18



3. ALL REED RELAYS TO BE H.V. TYPE
2. ALL COILS RELAY TO BE DUAL TBJ 192
1. ALL DIODES TO BE FD100

NOTES

Figure 5-40. Schematic, Collector Programing Relay Assembly A18

Section VI
Replacement Parts

6-1. GENERAL

6-2. Tables 6-1 through 6-19 list replacement parts for the Model 6200B/P. The tables detail circuit reference, description, manufacturer and Systron-Donner part number.

6-3. ORDERING INFORMATION

6-4 Address replacement orders to an authorized sales manager, Measurement Products Division, Systron-Donner Corporation, 888 Galindo Street, Concord, California 94520.

6-5. Include with the order:

a. Model and Serial number of the instrument.
b. Fairchild Instrumentation part number
c. Circuit reference, assembly number, and/or a complete description.

6-6. To order a part not listed in tables 6-1 through 6-19, provide as complete a description of the part as possible together with its function and location.

ABBREVIATIONS

AB	Allen-Bradley Company
AH & H	Arrow-Hart & Hageman Electronics Company
Alco	Alco Electronic Products
AMI	Amelco Semiconductor, Inc.
Beck	Beckman Instruments
Birnbach	Birnbach Radio Co., Inc.
Bourns	Bourns, Inc., Trimpot Division
Brill	Brill Electronics
CEC	Consolidated Electrodynamics Corporation
Centralab	Centralab Div., Globe-Union, Inc.
CGW	Corning Glass Works
Clare	C.P. Clare & Company
Cornell	Cornell-Dubilier Electronics
Dale	Dale Electronics
Dumont	Dumont Div., Fairchild Camera & Instrument
Dura Mica	Dura Mica Corporation
Edal	Edal Industries
Elco	Elco Corporation
Electrol	Electrol, Inc.
Elmar	Elmar Electronics
Elmenco	The Electro Motive Mfg. Co.
Elpac	Elpac, Inc.
Erie	Erie Technological Products Corp.
FI	Fairchild Instrumentation
FS	Fairchild Semiconductor
GE	General Electric
Gordos	Gordos Corporation
Grayhill	Grayhill, Inc.
H.H. Smith	Herman H. Smith, Inc.
Hopkins	Hopkins Engineering Company
IERC	International Electronic Research Corporation
Kiernulf	Kiernulf Electronics, Inc.
Klixon	Klixon Div., Texas Instruments
Littlefuse	Littlefuse, Inc.
Magnecraft	Magnecraft Electric Company
Marco	Marco-Oaks Industries
Mota	Motorola Semiconductor Products Division
Moulton	Moulton Electronics, Inc.
Ohmite	Ohmite Manufacturing, Inc.
Rich	Rich Industries
RN	Robinson-Nugent Company
Siemens	Siemens-America, Inc.
Spectrol	Spectrol Electronics
Sprague	Sprague Electrical Company
Superior Elec.	The Superior Electronics Co.
Textool	Textool Products, Inc.
Tower	Tower Manufacturing Corp.
Tranex	Tranex Corporation
TRW	TRW Capacitor Company
Turbo-Jet	Turbo-Jet Products, Inc.
West. Elec. Mot.	Western Electro Motive Corp.
Winchester	Winchester Electronics Div., Litton Industries

Table 6-1. Model 6200B/P Main Frame Parts List

Circuit Ref.	Description	Manufacturer	Number
A1	±45 Volt Power Supply Assembly	FI	98000201
A2	225 Volt Power Supply Assembly	FI	98000202
A3	Collector Current Relay #1 Assembly	FI	98000203
A4	Collector Current Relay #2 Assembly	FI	98000204
A5	Vertical Amplifier Assembly	FI	98000205
A6	Collector Voltage Relay Assembly	FI	98000206
A7	Horizontal Amplifier Assembly	FI	98000207
A8	Not assigned		
A9	Pulsed Base & Multiplier Assembly	FI	98000309
A10	Base Rang e & Polarity Assembly	FI	98000210
A11	Base Generator Assembly	FI	98000211
A12	Last Step Reset Assembly	FI	98000212
A13	Zero Step Amplifier Assembly	FI	98000213
A14	Step Amplifier Assembly	FI	98000214
A15	HV Power Supply Assembly	FI	98000215
A16	Sweep Rectifier Assembly	FI	98000316
A17	Collector Series Resistors Assembly	FI	98000317
A18	Collector Programer Assembly	FI	98000318
XA1	Connector, 22 pin		
XA2 through XA7	Same as A1 connector		
XA9 through	Same as A1 connector		
C1	Capacitor, fixed, 56 μF, 75 V	Sprague	03279190
C2	Same as C1		
C3	Capacitor, fixed, 1500 μF, 100 V	Sprague	03287300
C4	Capacitor, fixed 10,000 pF, 600 V	Centralab	03281750
C5	Same as C4		
C6	Capacitor, fixed, 1 μF, 200 V		03279010
C7 through C9	Not assigned		
C10	Same as C3		
C11 through C13	Not assigned		
C14A	Capacitor, fixed, 15 μF, 400 V	Sprague	03287290
C14B	Same as C14A		
CB1	Circuit Breaker	Klexon	11008520
CR1	Diode, FD100	FS	26006930

Table 6-1. Model 6200B/P Main Frame Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
CR2	Diode, 1N4003	FS	26011080
CR3	Same as CR2		
CR4	Diode, 1N2992	FS	26014280
CR5	Same as CR4		
DS1	Lamps, 6.3 V	GE	12013850
DS2	Same as DS1		
F1	Fuseholder Buss	Littlefuse	11009210
	Fuse, 125 V, 2 A	Littlefuse	11000990
J1	Connector, 75 pin	Winchester	09060970
J2	Connector, power	Tower	09061480
Q1	Transistor, 2N3055	FS	26012140
Q4	Same as Q1		
Q5	Same as Q1		
Q30	Transistor, 2N3442		26015890
Q31	Same as Q30		
R21	Resistor, fixed, 1 kΩ ±5%, ½ W	AB	02030480
R100	Resistor, variable 1 kΩ	Spectrol	01111260
R101 through R111	Resistor, fixed, 100 Ω ±5%, ¼ W	AB	02354380
R112	Resistor, fixed, 14.7 kΩ ±1%, ½ W	CEC	02379550
R115	Resistor, fixed, 560 kΩ ±5%, 1 W	AB	02034140
R117	Resistor, fixed, 100 Ω ±1%, ½ W	CEC	02377470
R127	Resistor, fixed, 100 Ω ±1%, 25 W	Dale	02402140
R159	Resistor, fixed, 5 Ω ±1%, 10 W	Dale	02390520
R160	Resistor, fixed, 2.5 Ω ±1%, 25 W	Dale	02390550
R161	Same as R160		
R162	Resistor, fixed, 1 Ω ±1%, 25 W	Dale	02402120
R163	Resistor, fixed, 39 Ω ±5%, ½ W	AB	02030140
R164	Resistor, fixed, 82 Ω ±5%, ½ W	AB	02030220
R191	Resistor, variable, 50 kΩ	Bourns	01095300
R238	Resistor, variable, 50 Ω	AB	01111920
R241	Resistor, variable, 1 MΩ	AB	01111930
R242	Same as R241		
R243	Resistor, fixed, 1.1 kΩ ±5%, ½ W	AB	02030490
R244	Resistor, fixed, 3.0 kΩ ±5%, 1 W	AB	02033590
R245	Same as R127		
R246	Resistor, variable, 0.1 MΩ		01094700
RY1	Relay, KHP17011	Western Elect.	05034060
	Relay, socket & ring	Western Elect.	09066300

Table 6-1, Model 6200B/P Main Frame Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
S1	Switch, SPST (Part of R238)		
S2	Switch, Rotary, 11 Pos.	Centralab	05033220
S3	Switch, Rotary, 11 Pos.		05019331
S4	Switch		05034000
S5	Switch, 1 Pole, 2-11 Pos.	Centralab	05035740
S6	Same as S5		
S7	Switch, Rotary, 18 Pos.	FS	05039051
S8	Switch, Rotary, 16 Pos.	Marco	05039041
S9	Switch, Rotary, 2 Pole, 2-6 Pos.	Centralab	05019401
S10	Not assigned		
S11	Switch, DPDT	AH&H	05035680
S12	Same as S11		
S13	Switch, Toggle, DPDT	Alco	05033830
S14	Same as S13		
S15	Switch, Slide, SPST		05034320
S16	Switch, Slide, DPDT		05033390
T1	Transformer	FI	20016741
T2	Transformer, variable	Ohmite	20016761
T3	Transformer, Power Supply	Tranex	26017101
TP1	Post, Binding, Black	H.H. Smith	51023970
TP2	Same as TP1		
TP3	Same as TP1		
V1	Tube, CRT		25015640

Table 6-2. ±45 Volt Power Supply Assembly A1 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 10.0 μF, 50 V	Sprague	03267630
C2	Same as C1		
C3	Capacitor, fixed, 0.001 μF, 1000 V	Centralab	03270180
C4	Capacitor, fixed, 5000 pF, 1000 V	Elmar	03281740
C5	Same as C3		
C6	Capacitor, fixed, 1 MF, 35 V	Sprague	03279130
C7	Same as C1		
C8	Same as C3		
C9	Same as C4		
C10	Same as C1		
C11	Same as C3		
C12	Same as C6		
CR1	Diode, IN4003	FS	26011080
CR2	Same as CR1		
CR3	Diode, FD100	FS	26006930
CR4	Same as CR1		
CR5	Same as CR1		
CR6	Same as CR3		
CR7	Transistor, 2N3073	FS	26011430
CR8	Same as CR7		
CR9	Transistor, S1201	FS	26003731
CR10	Same as CR9		
CR11	Same as CR3		
CR12	Same as CR3		
Q1	Not assigned		
Q2	Transistor, S1201	FS	26003731
Q3	Transistor, 2N3114	FS	26008620
Q4	Transistor, 2N3072	FS	26008560
Q5	Same as Q4		
Q6	Transistor, 2N3638	FS	26011930
Q7	Not assigned		
Q8	Same as Q6		
Q9	Not assigned		
Q10	Same as Q6		
Q11	Same as Q4		
Q12	Same as Q3		
Q13	Same as Q3		
Q14	Same as Q2		
Q15	Same as Q2		
R1	Resistor, fixed, 51 kΩ ±5%, ½ W	AB	02030890
R2	Resistor, fixed, 56 Ω ±5%, ½ W	AB	02030180

Table 6-2. ±45 Volt Power Supply Assembly A1 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R3	Resistor, fixed, 10 kΩ ±5%, ½ W	AB	02030720
R4	Resistor, fixed, 100 Ω ±5%, ½ W	AB	02030240
R5	Resistor, fixed, 12 Ω ±5%, 10 W	Sprague	02223570
R6	Resistor, fixed, 1 kΩ ±5%, ½ W	AB	02030480
R7	Resistor, fixed, 15 kΩ ±5%, ½ W	AB	02030760
R8	Resistor, fixed, 20 kΩ ±5%, ½ W	AB	02030790
R9	Same as R8		
R10	Resistor, fixed, 470 Ω ±5%, ½ W	AB	02030400
R11	Resistor, fixed, 390 Ω ±5%, ½ W	AB	02030380
R12	Same as R8		
R13	Resistor, fixed, 5.1 kΩ ±5%, ½ W	AB	02030650
R14	Resistor, fixed, 5 Ω ±5%, 5 W	Sprague	02391120
R15	Resistor, fixed, 4.3 kΩ ±5%, ½ W	AB	02030630
R16	Resistor, fixed, 40.2 kΩ ±1%, ½ W	CEC	02379970
R17	Resistor, fixed, 6.65 kΩ ±1%, ¼ W	RN	02391910
R18	Resistor, variable, 2 kΩ , ¾ W	Bourns	01111090
R19	Same as R5		
R20	Resistor, fixed, 62 Ω ±5%, ½ W	AB	02030190
R21	Same as R3		
R22	Same as R1		
R23	Same as R4		
R24	Same as R6		
R25	Same as R7		
R26	Same as R11		
R27	Same as R8		
R28	Same as R8		
R29	Same as R8		
R30	Same as R13		
R31	Same as R14		
R32	Same as R11		
R33	Same as R15		
R34	Same as R16		
R35	Same as R17		
R36	Same as R18		
TP1	Test, Jack, BL1177	Birnbach	09062500
TP2	Test, Jack, Red 1177	Birnbach	09062520
TP3	Test, Jack, Blue 1177	Birnbach	09062560

Table 6-3. +225 Volt Power Supply Assembly A2 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 10 μF, 50 V	Sprague	03267630
C2	Capacitor, fixed, 10,000 pF, 600 V	TRW	03281750
C3	Capacitor, fixed, 2000 pF, 1000 V	Cornell	03281710
C4	Capacitor, fixed, 0.1 μF, 75 V	Centralab	03279540
C5	Capacitor, fixed, 2 μF, 250 V	Siemans	03279030
C6	Capacitor, fixed, 40,000 pF, 600 V	TRW	03281780
CR1	Rectifier, Bridge	Mota	26012370
CR2	Transistor, 2N3073	FS	26011430
CR3	Diode, FD100	FS	26006930
CR4	Same as CR3		
CR5	Same as CR3		
CR6	Same as CR3		
CR7	Same as CR3		
CR8	Same as CR3		
CR9	Same as CR3		
CR10	Same as CR3		
CR11	Same as CR3		
Q1	Transistor, 2N3114	FS	26008620
Q2	Same as Q1		
Q3	Transistor, S1201	FS	26003731
Q4	Transistor, 2N3738	FS	26015880
R1	Resistor, fixed, 1.2 kΩ ±5%, 10 W	Sprague	02223840
R2	Resistor, fixed, 1 kΩ ±5%, ½ W	AB	02030480
R3	Resistor, fixed, 180 kΩ ±5%, ½ W	AB	02031020
R4	Resistor, fixed, 100 kΩ ±5%, 2 W	AB	02036960
R5	Resistor, fixed, 15 kΩ ±5%, ½ W	AB	02030760
R6	Resistor, fixed, 75 kΩ ±5%, ½ W	AB	02030930
R7	Resistor, fixed, 180 Ω ±5%, 2 W	AB	02036300
R8	Resistor, fixed, 6.8 kΩ ±5%, ½ W	AB	02030680
R9	Resistor, fixed, 200 kΩ ±1%, ½ W	CEC	02380640
R10	Resistor, fixed, 4.99 kΩ ±1%, ½ W	CEC	02379100
R11	Resistor, variable, 2 kΩ		01111090
TP1	Test, Jack, BL1177	Birnbach	09062500
TP2	Test, Jack, Yellow	Birnbach	09062540
	Heat Sink		27004530

Table 6-4. Collector Current Assembly A3 Parts List

Circuit Ref.	Description	Manufacturer	Number
CR1 through CR19	Diode, FD100	FS	26006930
K1	Coil, Reed Relay	Magnecraft	21103150
	Reed, Relay	Clare	05033910
K2 through K7	Same as K1		
R1	Resistor, fixed, 52.3 kΩ ±1%, ½ W	CEC	02380080
R2	Resistor, fixed, 25.5 kΩ ±1%, ½ W	CEC	02379780
R3	Resistor, fixed, 10 kΩ ±1%, 2 W	Dale	02390020

Table 6-5. Collector Current Relay Assembly A4 Parts List

Circuit Ref.	Description	Manufacturer	Number
CR1	Diode, FD100	FS	26006930
CR2 through CR16	Same as CR1		
CR17	Diode, IN4003	FS	26011080
CR18 through CR22	Same as CR17		
CR23	Same as CR1		
K1	Coil, Reed Relay	Turbo-Jet	21103150
	Reed, Relay	Clare	05033910
K2 through K8	Same as K1		
R1	Resistor, fixed, 39 kΩ ±5%, ½ W	AB	02030860
R2	Same as R1		
R3	Resistor, fixed, 25 Ω ±1%, 5 W	Dale	02401970
R4	Resistor, fixed, 50 Ω ±1%, 2 W	Dale	02401960
R5	Resistor, fixed, 100 Ω ±1%, 1 W	Dale	02402010
R6	Resistor, fixed, 249 Ω ±1%, ½ W	CEC	02377850
R7	Resistor, fixed, 499 Ω ±1%, ½ W	CEC	02378140
R8	Resistor, fixed, 1 kΩ ±1%, ½ W	CGW	02378430
R9	Resistor, fixed, 2.49 kΩ ±1%, ½ W	CEC	02378810
R10	Resistor, fixed, 4.99 kΩ ±1%, ½ W	CEC	02379100

Table 6-6. Vertical Amplifier Assembly A5 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 270 pF, 500V	Elmenco	03281430
CR1 through CR6	Diode, FD100	FS	26006930
K1	Coil, Relay, 28V	Clare	05036490
K2	Same as K1		
Q1	Transistor, field effect, U1283 (μ1283)	AML	26003751
Q2	Same as Q1		
Q3	Transistor, S17395	FS	26003741
Q4	Same as Q3		
Q5	Transistor S1201	FS	26003731
Q6	Same as Q5		
Q7	Transistor, 2N3738	FS	26015880
Q8	Same as Q7		
R1	Resistor, fixed, 100 kΩ ±5%, ½W	AB	02030960
R2	Same as R1		
R3	Resistor, fixed 20 kΩ ±5%, ½W	AB	02030790
R4	Resistor, fixed, 36 kΩ ±5%, ½W	AB	02030850
R5	Resistor, variable, 10 kΩ	Beck	01111320
R6	Same as R4		
R7	Same as R3		
R8	Resistor, fixed, 24.9 kΩ ±1%, ½W	CEC	02379770
R9	Resistor, fixed 20 kΩ ±1%, ½W	CEC	02379680
R10	Same as R8		
R11	Resistor, fixed, 1.96 kΩ ±1%, ½W	CEC	02378710
R12	Resistor, fixed, 11 kΩ ±5%, ½W	AB	02030730
R13	Same as R12		
R14	Resistor, fixed, 4.7 kΩ ±5%, ½W	AB	02030640
R15	Resistor, fixed, 15 kΩ ±5%, ½W	AB	02030760
R16	Resistor, variable, 2 kΩ	Beck	01111090
R17	Resistor, fixed, 2 kΩ ±1%, ½W	CEC	02378720
R18	Resistor, fixed, 100 kΩ ±1%, ½W	CEC	02380350
R19	Same as R18		
R20	Resistor, fixed, 16 kΩ ±5%, ½W	AB	02030770
R21	Same as R20		
R22	Resistor, fixed, 25 kΩ ±5%, 5W	Sprague	02402730
R23	Same as R22		
R24	Resistor, fixed, 91 kΩ ±5%, ¼W	AB	02355080

Table 6-7. Collector Voltage Relay Assembly A6 Parts List

Circuit Ref.	Description	Manufacturer	Number
CR1	Diode, FD100	FS	26006930
CR2 through CR22	Same as CR1		
K1	Coil, dual relay	Turbo-Jet	21102160
K1A	Switch, vacuum reed	Gordos	05036150
K1B	Same as K1A		
K2	Relay 28 V, Coil	Clare	05036500
K3	Same as K2		
K4 through K10	Same as K2		
K11	Same as K1		
K11A	Same as K1A		
K11B	Same as K1A		
R1	Resistor, fixed, 499 kΩ ±1%, ½W	CEC	02381020
R2	Resistor, fixed, 301 kΩ ±1%, ½W	CEC	02380810
R3	Resistor, fixed, 100 kΩ ±1%, ½W	CEC	02380350
R4	Resistor, fixed, 50 kΩ ±1%, ½W	CEC	02380060
R5	Resistor, fixed, 30.1 kΩ ±1%, ½W	CEC	02379850
R6	Resistor, fixed, 10 kΩ ±1%, ½W	CEC	02379390
R7	Resistor, fixed, 4.99 kΩ ±1%, ½W	CEC	02379100
R8	Resistor, fixed, 3.01 kΩ ±1%, ½W	RN	02391830
R9	Resistor, fixed, 1 kΩ ±1%, ½W	CEC	02378430
R10	Same as R9		
R11	Same as R2		
R12	Same as R3		
R13	Same as R4		
R14	Same as R5		
R15	Same as R6		
R16	Same as R7		
R17	Same as R8		
R18	Same as R9		
R19	Same as R9		
R20	Same as R1		

Table 6-8. Horizontal Amplifier Assembly A7 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 270 pF, 500V	Elmenco	03281430
CR1	Diode, FD100	FS	26006930
CR2 through CR13	Same as CR1		
DS1	Lamp, Neon	Brill	12013130
K1	Coil, relay, 28V	Electrol	05036490
K2 through K6	Same as K1		
Q1	Transistor, U1283	AML	26003751
Q2	Same as Q1		
Q3	Transistor, 2N3114	FS	26008620
Q4	Same as Q3		
Q5	Transistor, S1201	FS	26003731
Q6	Same as Q5		
Q7	Transistor, 2N3738	FS	26015880
Q8	Same as Q7		
R1	Resistor, fixed, 100 kΩ ±5%, ½W	AB	02030960
R2	Same as R1		
R3	Resistor, fixed, 20 kΩ ±5%, ½W	AB	02030790
R4	Resistor, fixed, 36 kΩ ±5%, ½W	AB	02030850
R5	Resistor, variable, 10 kΩ	Beck	01111330
R6	Same as R4		
R7	Same as R3		
R8	Resistor, fixed, 24.9 kΩ ±1%, ½W	CEC	02379770
R9	Resistor, fixed, 4.02 kΩ ±1%, ½W	CEC	02379010
R10	Same as R8		
R11	Resistor, fixed, 8.06 kΩ ±1%, ½W	CEC	02379300
R12	Resistor, fixed, 20 kΩ ±1%, ½W	CGW	02379680
R13	Resistor, fixed, 1.96 kΩ ±1%,½W	CGW	02378710
R14	Resistor, variable, 100Ω	Beck	01111340
R15	Resistor, fixed, 698Ω ±1%, ½W	CEC	02378280
R16	Same as R14		
R17	Resistor, fixed, 301Ω ±1%, ½W	CEC	02377930
R18	Resistor, fixed, 18.2 kΩ ±1%, ½W	CEC	02379640
R19	Resistor, fixed, 7.5 kΩ ±5%, ½W	AB	02030690
R20	Same as R18		
R21	Resistor, fixed, 12 kΩ ±5%, ½W	AB	02030740
R22	Resistor, fixed, 100 kΩ ±1%, ½W	CEC	02380350

Table 6-8. Horizontal Amplifier Assembly A7 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R23	Resistor, variable, 2 kΩ	Beck	01111090
R24	Resistor, fixed, 3.01 kΩ ±1%, ½W	CEC	02378890
R25	Same as R22		
R26	Resistor, fixed, 16 kΩ ±5%, ½W	AB	02030770
R27	Same as R26		
R28	Resistor, fixed, 25 kΩ ±5%, 5W	Sprague	02402730
R29	Same as R28		
R30	Resistor, fixed, 1.2 MΩ ±5%, ¼W	AB	02355350
R31	Resistor, fixed, 270 kΩ ±5%, ¼W	AB	02355190
R32	Resistor, fixed, 39 kΩ ±5%, ¼W	AB	02354990
	Resistor, fixed, 43 kΩ ±5%, ¼W	AB	02355000
	Resistor, fixed, 24 kΩ ±5%, ¼W	AB	02354940
	Resistor, fixed, 30 kΩ ±5%, ¼W	AB	02354960
	Resistor, fixed, 36 kΩ ±5%, ¼W	AB	02354980
R33	Resistor, fixed, 240 kΩ ±5%, ¼W	AB	02355180
	Resistor, fixed, 300 kΩ ±5%, ¼W	AB	02355200
	Resistor, fixed, 360 kΩ ±5%, ¼W	AB	02355220
	Heat Sink		27004410

Table 6-9. Multiplier and Pulsed Base Assembly A9 Parts List

Circuit Ref.	Description	Manufacturer	Number
CR1	Diode, FD100	FS	26006930
CR2 through CR6	Same as CR1		
K1	Coil, relay, 28 V	Clare	05036500
K2	Coil, relay, 28 V	Electro	05036490
K3 through K6	Same as K2		
R1	Resistor, fixed, 301 Ω ±1%, ½ W	CEC	02377930
R2	Same as R1		
R3	Resistor, fixed, 100 Ω ±1%, ½ W	CEC	02377470
R4	Same as R3		
R5	Not assigned		
R6	Not assigned		
R7	Same as R1		
R8	Resistor, fixed, 1 MΩ ±5%, ½ W	AB	02031200

Table 6-10. Base Generator Programer Assembly A10 Parts List

Circuit Ref.	Description	Manufacturer	Number
CR1 through CR14	Diode, FD100	FS	26006930
K1	Coil, relay—	Turbo-Jet	05035560
	Reed, relay	Clare	05033910
K2	Same as K1		
K3	Same as K1		
K4	Coil, relay, 28V	Electrol	05036490
K5	Not assigned		
K6	Not assigned		
K7	Coil, relay, 28V	Clare	05036500
K8	Same as K7		
R1	Resistor, fixed, 10Ω ±0.1%, 10W	Dale	02390290
R2	Resistor, fixed, 100Ω ±0.1%, 3W	Dale	02390060
R3	Resistor, fixed, 1 kΩ ±1%, ½W	CGW	02378430
R4	Resistor, fixed, 10 kΩ ±1%, ½W, Factory Select	CGW	02379390
	Resistor, fixed, 11 kΩ ±1%, ½W Factory Select	CGW	02379430
	Resistor, fixed, 110 kΩ ±5%, ¼W, Factory Select	AB	02355100
	Resistor, fixed, 120 kΩ ±5%, ¼W, Factory Select	AB	02355110
	Resistor, fixed, 130 kΩ ±5%, ¼W, Factory Select	AB	02355120
	Resistor, fixed, 150 kΩ ±5%, ¼W, Factory Select	AB	02355130
R5	Resistor, fixed, 110 kΩ ±1%, ½W, Factory Select	CGW	02380390
	Resistor, fixed, 1.2 MΩ ±5%, ¼W, Factory Select	AB	02355350
	Resistor, fixed, 1.3 MΩ ±5%, ¼W, Factory Select	AB	02355360
	Resistor, fixed, 1.5 MΩ ±5%, ¼W, Factory Select	AB	02355370
R6	Resistor, fixed, 1 MΩ ±1%, ½W	CEC	02381310
R7	Resistor, fixed, 1 kΩ ±5%, ½W	AB	02381310
R8	Resistor, fixed, 47 kΩ ±5%, ¼W, Factory Select	AB	02355010
	Resistor, fixed, 51 kΩ ±5%, ¼W, Factory Select	AB	02355020
	Resistor, fixed, 56 kΩ ±5%, ¼W, Factory Select	AB	02355030
	Resistor, fixed, 62 kΩ ±5%, ¼W, Factory Select	AB	02355040
	Resistor, fixed, 68 kΩ ±5%, ¼W, Factory Select	AB	02355050
	Resistor, fixed, 75 kΩ ±5%, ¼W, Factory Select	AB	02355060
	Resistor, fixed, 82 kΩ ±5%, ¼W, Factory Select	AB	02355070
R9	Resistor, fixed, 1.5 MΩ ±5%, ¼W, Factory Select	AB	02355370
	Resistor, fixed, 1.6 MΩ ±5%, ¼W, Factory Select	AB	02355380
	Resistor, fixed, 1.8 MΩ ±5%, ¼W, Factory Select	AB	02355390
	Resistor, fixed, 2.2 MΩ ±5%, ¼W, Factory Select	AB	02355410
	Resistor, fixed, 2.7 MΩ ±5%, ¼W, Factory Select	AB	02355430
R10	Resistor, fixed, 11 MΩ ±5%, ¼W, Factory Select	AB	02355580
	Resistor, fixed, 13 MΩ ±5%, ¼W, Factory Select	AB	02355600
	Resistor, fixed, 15 MΩ ±5%, ¼W, Factory Select	AB	02355610

Table 6-11. Base Step Counter Assembly A11 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 5000 pF, 1000 V	Cornell	03281740
C2	Same as C1		
C3	Capacitor, fixed, 0.001 μF, 600 V		03270180
C4	Same as C3		
C5	Capacitor, fixed, 1000 μF, 500 V	Dura-Mica	03281320
C6	Same as C5		
C7	Same as C3		
C8	Same as C3		
C9	Same as C5		
C10	Same as C5		
C11	Same as C3		
C12	Same as C3		
C13	Same as C5		
C14	Same as C5		
C15	Same as C3		
C16	Same as C3		
C17	Same as C5		
C18	Same as C5		
CR1 through CR20	Diode, FD200	FS	26011850
Q1 through Q10	Transistor, 2N3693	FS	26012020
R1	Resistor, fixed, 5.1 kΩ ±5%, ½ W	AB	02030650
R2	Resistor, fixed, 15 kΩ ±5%, ¼ W	AB	02354890
R3	Same as R2		
R4	Same as R2		
R5	Resistor, fixed, 10 kΩ ±5%, ¼ W	AB	02354850
R6	Same as R5		
R7	Resistor, fixed, 100 kΩ ±5%, ¼ W	AB	02355090
R8	Resistor, fixed, 12 kΩ ±5%, ¼ W	AB	02354870
R9	Same as R7		
R10	Same as R7		
R11	Resistor, fixed, 91 kΩ ±5%, ¼ W	AB	02355080
R12	Same as R11		
R13	Resistor, fixed, 56 kΩ ±5%, 1 W	AB	02033900
R14	Same as R8		
R15	Same as R7		

Table 6-11. Base Step Counter Assembly A11 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R16	Same as R7		
R17	Same as R11		
R18	Same as R11		
R19	Same as R13		
R20	Same as R8		
R21	Same as R7		
R22	Same as R7		
R23	Same as R11		
R24	Same as R11		
R25	Same as R13		
R26	Same as R8		
R27	Same as R7		
R28	Same as R7		
R29	Same as R11		
R30	Same as R11		
R31	Same as R13		
R32	Same as R5		
R33	Same as R5		
R34	Resistor, fixed, 402 kΩ ±1%, ½ W	CEC	02380930
R35	Same as R34		
R36	Same as R5		
R37	Same as R5		
R38	Resistor, fixed, 200 kΩ ±1%, ½ W	CEC	02380640
R39	Same as R38		
R40	Same as R5		
R41	Same as R5		
R42	Resistor, fixed, 100 kΩ ±1%, ½ W	CEC	02380350
R43	Same as R42		
R44	Same as R5		
R45	Same as R5		
R46	Resistor, fixed, 50 kΩ ±1%, ½ W	CEC	02380060
R47	Same as R46		

Table 6-12. Pulsed Base and Last Step Reset Assembly A12 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 0.1 μF, 75 V	Centralab	03279540
C2	Capacitor, fixed, 0.22 μF, 50 V	Elpac	03284240
C3	Capacitor, fixed, 5000 pF, 1000 V	Centralab	03281740
C4	Capacitor, fixed, .022 μF, 200 V	TRW	03278930
C5	Same as C1		
C6	Capacitor, fixed, 10,000 pF, 600 V	Centralab	03281750
C7	Same as C6		
CR1	Diode, FD100	FS	26006930
CR2	Same as CR1		
CR3	Same as CR1		
Q1	Transistor, 2N3072	FS	26008560
Q2	Transistor, FSP-30	FS	26012090
Q3	Same as Q1		
Q4	Same as Q1		
Q5	Transistor, 2N708	FS	26010460
Q6	Transistor, 2N2297	FS	26010440
R1	Resistor, fixed, 100 kΩ ±5%, ½ W	AB	02030960
R2	Resistor, fixed, 1 kΩ ±5%, ½ W	AB	02030480
R3	Resistor, fixed, 3.6 kΩ ±5%, ½ W	AB	02030610
R4	Same as R2		
R5	Same as R1		
R6	Resistor, variable, 50 kΩ	Bournes	01111330
R7	Resistor, fixed, 75 kΩ ±5%, ½ W	AB	02030930
R8	Resistor, fixed, 12 kΩ ±5%, ½ W	AB	02030740
R9	Resistor, fixed, 10 kΩ ±5%, ½ W	AB	02030720
R10	Same as R9		
R11	Resistor, fixed, 4.3 kΩ ±5%, ½ W	AB	02030630
R12	Resistor, fixed, 39 kΩ ±5%, ½ W	AB	02030860
R13	Resistor, fixed, 51 kΩ ±5%, ½ W	AB	02030890
R14	Resistor, fixed, 56 kΩ ±5%, ½ W	AB	02030900
R15	Resistor, fixed, 2.4 kΩ ±5%, ½ W	AB	02030570
R16	Resistor, variable, 1 kΩ	Bournes	01111310
R17	Resistor, fixed, 22 kΩ ±5%, ½ W	AB	02030800
R18	Resistor, fixed, 24 kΩ ±5%, ½ W	AB	02030810
R19	Resistor, fixed, 8.2 kΩ ±5%, ½ W	AB	02030700
R20	Resistor, fixed, 100 Ω ±5%, ½ W	AB	02030240
R21	Resistor, fixed, 8.06 kΩ ±1%, ½ W	CEC	02379300
R22	Resistor, variable, 5 kΩ	Bournes	01111360
TP1	Test, Jack, PC Yellow	Birnbach	09062540
TP2	Test, Jack, PC Purple	Birnbach	09062570

Table 6-13. Feedback Amplifier and Zero Step Assembly A13 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 0.01 μF, 200 V	TRW	03278910
C2	Same as C1		
C3	Capacitor, fixed, 100 pF, 500 V	Elmenco	03281320
C4	Capacitor, fixed, 51 pF, 500 V	Elmenco	03175210
C5	Same as C1		
C6	Capacitor, fixed, 10,000 pF, 600 V	TRW	03281750
Q1	Transistor, 2N3114	FS	26008620
Q2	Same as Q1		
Q3	Same as Q1		
Q4	Transistor, S16986	FS	26003831
Q5	Transistor, 2N2920	FS	26011350
Q6	Same as Q1		
Q7	Same as Q5		
Q8	Same as Q4		
R1	Resistor, fixed, 2.2 kΩ ±5%, ½W	AB	02030560
R2	Resistor, fixed, 10 kΩ ±5%, ½W	AB	02030720
R3	Resistor, fixed, 56 kΩ ±5%, ½W	AB	02030900
R4	Resistor, fixed, 620 kΩ ±5%, ½W	AB	02031150
R5	Resistor, fixed, 15 MΩ ±5%, ½W	AB	02031480
R6	Resistor, fixed, 3 MΩ ±5%, ½W, Factory Select	AB	02031310
	Resistor, fixed, 10 MΩ ±5%, ½W, Factory Select	AB	02031440
	Resistor, fixed, 11 MΩ ±5%, ½W, Factory Select	AB	02031450
	Resistor, fixed, 12 MΩ ±5%, ½W, Factory Select	AB	02031460
	Resistor, fixed, 13 MΩ ±5%, ½W, Factory Select	AB	02031470
	Resistor, fixed, 15 MΩ ±5%, ½W, Factory Select	AB	02031480
	Resistor, fixed, 16 MΩ ±5%, ½W, Factory Select	AB	02031490
	Resistor, fixed, 18 MΩ ±5%, ½W, Factory Select	AB	02031500
	Resistor, fixed, 20 MΩ ±5%, ½W, Factory Select	AB	02031510
R7	Resistor, fixed, 910 kΩ ±5%, ½W	AB	02031190
R8	Resistor, variable 5 kΩ	Beck	01094860
R9	Resistor, fixed, 2.4 kΩ ±5%, ½W	AB	02030570
R10	Resistor, fixed, 3.0 kΩ ±5%, ½W	AB	02030590
R11	Resistor, fixed, 36 kΩ ±5%, ½W	AB	02030850
R12	Same as R3		
R13	Resistor, fixed, 330 kΩ ±5%, ½W	AB	02031080
R14	Resistor, fixed, 100 kΩ ±5%, ½W	AB	02030960
R15	Resistor, fixed, 124 kΩ ±1%, ½W	CEC	02380440
R16	Resistor, fixed, 14.7 kΩ ±1%, ½W	CEC	02379550
R17	Resistor, fixed, 3.9 kΩ ±5%, ½W	AB	02030620
R18	Resistor, fixed, 100Ω ±1%, ½W	CEC	02377470
R19	Resistor, fixed, 499 kΩ ±1%, ½W	CEC	02381020
R20	Same as R3		
TP1	Test, Jack, BL1177	Birnbach	09062500
TP2	Test, Jack, Grey 1177	Birnbach	09062580
TP3	Test, Jack, Green	Birnbach	09062550

Table 6-14. Base Step Amplifier Assembly A14 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 10 pF, 500 V	Elmenco	03175060
C2	Capacitor, fixed, 0.01 μF, 50 V	Sprague	03281960
C3	Capacitor, fixed, 430 pF, 500 V	Elmenco	03281480
C4	Capacitor, fixed, 10,000 pF, 600 V	TRW	03281750
C5	Capacitor, fixed, 0.01 μF, 200 V	TRW	03278910
C6	Same as C2		
CR1	Diode, FD100	FS	26006930
CR2	Same as CR1		
CR3	Same as CR1		
CR4	Same as CR1		
CR5	Diode, FD300	FS	26012320
Q1	Transistor, S16986	FS	26003831
Q2	Transistor, 2N2484	FS	26010670
Q3	Same as Q2		
Q4	Transistor, 2N2920	FS	26011350
Q5	Same as Q1		
Q6	Same as Q2		
Q7	Transistor, 2N3931	FS	26015470
Q8	Transistor, 2N3114	FS	26008620
Q9	Same as Q8 (no heatsink)		
Q10	Same as Q7 (no heatsink)		
R1	Resistor, fixed, 5.1 kΩ ±5%, ½ W	AB	02030650
R2	Same as R1		
R3	Resistor, fixed, 10 kΩ ±.1%, ¼ W	CGW	02389030
R4	Same as R3		
R5	Resistor, fixed, 100 kΩ ±0.1%, ¼ W	Rich	02389150
R6	Resistor, fixed, 402 kΩ ±1%, ½ W	CEC	02380930
R7	Resistor, fixed, 75 kΩ ±5%, ½ W	AB	02030930
R8	Resistor, fixed, 200 kΩ ±1%, ½ W	CEC	02380640
R9	Resistor, fixed, 1.2 kΩ ±5%, ½ W	AB	02030500
R10	Resistor, variable, 500 Ω	Beck	01094900
R11	Same as R9		
R12	Resistor, fixed, 180 kΩ ±5%, ½ W	AB	02031020
R13	Resistor, fixed, 300 kΩ ±5%, ½ W	AB	02031070
R14	Resistor, fixed, 6.8 kΩ ±5%, ½ W	AB	02030680
R15	Same as R14		
R16	Resistor, fixed, 2.7 kΩ ±5%, ½ W	AB	02030580
R17	Resistor, fixed, 30 kΩ ±5%, ½ W	AB	02030830
R18	Resistor, fixed, 13 kΩ ±5%, ½ W	AB	02030750
R19	Resistor, fixed, 10 kΩ ±5%, ½ W	AB	02030720
R20	Resistor, fixed, 1 kΩ ±5%, ½ W	AB	02030480

Table 6-14. Base Step Amplifier Assembly A14 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R21	Same as R1		
R22	Resistor, fixed, 270 Ω ±5%, ½ W	AB	02030340
R23	Same as R22		
R24	Resistor, fixed, 10 Ω ±5%, ½ W	AB	02030000
R25	Same as R24		
R26	Resistor, fixed, 3.3 Ω ±5%, 1 W	AB	02402530
R27	Same as R20		
R28	Resistor, fixed, 2.7 Ω ±5%, 1 W	AB	02394540
R29	Same as R28		
R30	Same as R20		
R31	Same as R26		
R32	Same as R5		
R33	Resistor, fixed, 6.8 kΩ ±1%, 1/8 W	CGW	02373760
R34	Same as R33		
	Heatsink (Q7)	IERC	27004460
	Heatsink (Q8)	IERC	27004460

Table 6-15. High Voltage Power Supply Assembly A15 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 10 μF, 150V	Sprague	03287280
C2	Capacitor, fixed, 0.05 μF, 50V	Sprague	03281790
C3	Capacitor, fixed, 1 μF, 50V	Elpac	03279390
C4	Capacitor, fixed, 0.1 μF, 100V	Hopkins	03279360
C5	Capacitor, fixed, 20,000 pF, 600V	Centralab	03281770
C6	Capacitor, fixed, 0.0068 μF, 3kV	Sprague	03279520
C7	Same as C6		
C8	Capacitor, fixed, 10,000 pF, 600V	Centralab	03281750
CR1	Diode, FD100	FS	26006930
CR2	Diode, High Volt. Rect., G3R-102H	Edal	26011750
CR3	Same as CR1		
CR4	Diode, Zener, IN982, 75V	Mota	26011040
CR5	Same as CR1		
Q1	Transistor, DTS-413	FS	26011910
Q2	Transistor, 2N3107	FS	26012170
Q3	Transistor, 2N2484	FS	26010670
Q4	Same as Q3		
R1	Not assigned		
R2	Resistor, fixed, 680Ω ± 5%, ½W	AB	02030440
R3	Resistor, fixed, 4.7k ± 5%, ½W	AB	02030640
R4	Resistor, fixed, 5.6 kΩ ± 5%, ½W	AB	02030660
R5	Resistor, fixed, 4.7Ω ± 5%, 1W	AB	02402550
R6	Resistor, fixed, 39 kΩ ± 5%, ½W	AB	02030860
R7	Resistor, fixed, 820 kΩ ±5%, ½W	AB	02031180
R8	Resistor, fixed, 10 kΩ ±5%, ½W	AB	02030720
R9	Same as R8		
R10	Not assigned		
R11	Resistor, fixed, 27 kΩ ±5%, ½W	AB	02030820
R12	Resistor, fixed, 1 MΩ ±5%, ½W	AB	02031200
R13	Resistor, fixed, 1.8 MΩ ± 5%, 1W	AB	02034260
R14	Same as R13		
R15	Same as R13		
R16	Same as R13		
R17	Resistor, fixed, 33 kΩ ±5%, ½W	AB	02030840
T1	Transformer, High Voltage	Dumont	20016851
F1	Fuse, 3/16A, FBPT		11009410

Table 6-16. Collector Phase Capacitors and Sweep Rectifier Assembly A16 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Not assigned		
C2	Not assigned		
C3	Not assigned		
C4	Capacitor, variable, 8-50 pF	Erie	03281840
C5	Same as C4		
C6	Same as C4		
C7	Capacitor, fixed, 47 pF, 1 kV	Centralab	03290180
C8	Not assigned		
C9	Same as C4		
C10	Same as C7		
C11	Not assigned		
C12	Same as C4		
C13	Not assigned		
C14	Not assigned		
C15	Same as C4		
C16	Not assigned		
C17	Not used	Factory Select	
	Capacitor, fixed 1 pF, 1000 V, Factory Select	Sprague	03291210
	Capacitor, fixed, 1.2 pF, 1000 V, Factory Select	Sprague	03291220
	Capacitor, fixed, 1.5 pF, 1000 V, Factory Select	Sprague	03291230
	Capacitor, fixed, 1.8 pF, 1000 V, Factory Select	Sprague	03291240
	Capacitor, fixed, 2.2 pF, 1000 V, Factory Select	Sprague	03291250
	Capacitor, fixed, 2.7 pF, 1000 V, Factory Select	Sprague	03291260
	Capacitor, fixed, 3.0 pF, 1000 V, Factory Select	Sprague	03291270
	Capacitor, fixed, 3.3 pF, 1000 V, Facotry Select	Sprague	03291280
	Capacitor, fixed, 3.9 pF, 1000 V, Factory Select	Sprague	03291290
	Capacitor, fixed, 4.7 pF, 1000 V, Factory Select	Sprague	03291300
	Capacitor, fixed, 5.0 pF, 1000 V, Factory Select	Sprague	03291310
	Capacitor, fixed, 5.6 pF, 1000 V, Factory Select	Sprague	03291320
	Capacitor, fixed, 6.8 pF, 1000 V, Factory Select	Sprague	03291330
	Capacitor, fixed, 8.2 pF, 1000 V, Factory Select	Sprague	03291340
	Capacitor, fixed, 10 pF, 1000 V, Factory Select	Sprague	03291350
C18	Same Factory Select possibilities as C17.		
CR1	Rectifier, Bridge	Moulton	26011840
R1	Resistor, fixed, 560 kΩ ±5%, 2 W	AB	02037140
R2	Same as R1		
R3	Same as R1		
R4	Same as R1		

Table 6-17. Collector Load Resistor Assembly A17 Parts List

Circuit Ref.	Description	Manufacturer	Number
CR1	Diode, FD100	FS	26006930
CR2	Same as CR1		
K1	Coil, relay,	Turbo-Jet	05035560
	Reed, relay	Clare	05033910
K2	Same as K1		
R1	Resistor, fixed, 5 Ω ±5%, 10 W	Sprague	02224230
R2	Resistor, fixed, 25 Ω ±5%, 5 W	Ohmite	02416990
R3	Resistor, fixed, 100 Ω ±5%, 20 W	Ohmite	02106480
R4	Resistor, fixed, 300 Ω ±5%, 50 W	Dale	02417000
R5	Resistor, fixed, 1 kΩ ±5%, 20 W	Ohmite	02106590
R6	Resistor, fixed, 3 kΩ ±5%, 20 W	Ohmite	02106700
R7	Resistor, fixed, 10 kΩ ±5%, 50 W	Dale	02417010
R8	Resistor, fixed, 30 kΩ ±5%, 20 W		02106870
R9	Resistor, fixed, 100 kΩ ±3%, 7 W	Dale	02394510
R10	Resistor, fixed, 1 MΩ ±5%, 2 W	AB	02037200
S10	Switch, Rotary		05819381

Table 6-18. Collector Programing Relay Assembly A18 Parts List

Circuit Ref.	Description	Manufacturer	Number
CR1	Diode, FD100	FS	26006930
CR2 through CR5	Same as CR1		
K1	Coil, relay, Dual	Turbo-Jet	21103260
	Switch, vacuum, reed 1.5	Gordos	05036150
K2 through K3	Same as K1		
K4	Coil, relay, Dual Switch, reed	Gordos	05036870
K5	Same as K4		

Table 6-19. Test Socket Assembly Parts List

Circuit Ref.	Description	Manufacturer	Number
S1	Switch, Lever 2-3 Pos.	Centralab	05019591
S2	Switch, Toggle, DPDT	Alco	05033830
S3	Switch, Pushbutton SPST N-0 Red	Graybill	05032190
S4	Switch, Pushbutton, SPST N-o Black	Graybill	05032550
TP1	Socket	Textool	09065460
TP2	Post, binding, black	Superior Elec.	51023970
TP3	Same as TP2		
TP4	Same as TP2		
TP5	Same as TP2		
TP6	Same as TP2		
TP7	Same as TP2		
TP8	Same as TP1		

APPENDIX A

Instruction Manual for

Model 3509B Curve Tracer Programer

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